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Utilization of Micro Tall Coconut accessions - promise for future

Sustainable and Profitable Coconut Based Mixed Farming through Scientific Soil Management in Southern Midland Laterites

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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 six State Centres situated in the states of Orissa, West Bengal, Maharashtra, Andhra Pradesh, Gujrat 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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Dear friends,

The Indian coconut sector is undergoing a transformative journey, adapting to evolving consumer preferences, technological advancements, and sustainable practices. The decreasing trend of prices of copra and coconut oil in the international and domestic market also necessitates the urgent need to diversify to value added products.

One of the most prominent trends in the Indian coconut sector is the surging global demand for coconut products. With increasing awareness about the health benefits of coconuts, the demand for coconut water, coconut oil especially virgin coconut oil, desiccated coconut, coconut milk and milk powder, coconut chips and various other innumerable coconut based products has witnessed a remarkable upswing. Indian coconut farmers are seizing this opportunity, by increasing the production and exploring new markets to meet the soaring international demand.

Technology is transforming the traditional coconut farming. Smart farming techniques, precision agriculture, and the integration of Internet of Things (IoT) devices are enhancing productivity and efficiency. Farmers are adopting sensor-based irrigation systems, drones for crop monitoring, and data analytics to optimize coconut cultivation. This technological integration not only boosts yields but also promotes sustainable farming practices.

The coconut sector is no longer limited to coconut oil and water. Entrepreneurs and farmers are exploring innovative ways to diversify innovative coconut products, such as coconut flour, coconut sugar, and coconut-based beauty and personal care items. This diversification not only adds value to the coconut industry but also opens up new avenues for export and business expansion.

Sustainability has become a key focus in the coconut sector, driven by consumer demand for ethically sourced and environmentally friendly products. Farmers are increasingly adopting organic farming methods, implementing waste reduction strategies, and exploring renewable energy sources. The push towards sustainability not only aligns with global trends but also positions Indian coconut products as premium and socially responsible in the international market.

The urgent need in the coconut sector is the increasing integration of the value chain. From farm to table, stakeholders need to collaborate to streamline production, processing, and distribution. This integration enhances product quality, reduces post-harvest losses, and ensures a more efficient supply chain. It also creates opportunities for smallholder farmers to participate in the global market by providing them with access to resources and markets.

The Indian coconut sector is undergoing a remarkable transformation, driven by a combination of global demand, technological advancements, diversification, sustainable practices, and value chain integration. As we navigate through this coconut revolution, it is imperative for stakeholders in the industry to continue the innovation and sustainability, ensuring that the Indian coconut sector remains a global leader in providing high-quality, diverse, and ethically produced coconut products.

Wishing all the readers a very happy and prosperous year ahead

Chairman,

Editorial Board

Utilization of Micro Tall Coconut accessions- promise for future

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All India Coordinated Research Project on Palms

ICAR – Central Plantation Crops Research Institute, Kasaragod

Coconut (*Cocos nucifera L.*) popularly known as 'Kalpa Vriksha' in the ancient Indian literature provides all the necessities of life. It is also called 'The tree of wealth' or 'The tree of life' in other parts of the world. Coconut has many uses, including providing food, beverage, wood, medicine and edible oil and ornamental aesthetics. With a crop area of about 1.9 million hectares, India is the world's third largest coconut producer, growing the crop in four of its southern states: Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. Coconut management varies from monocropping with sophisticated drip irrigation, to mixed gardening from home gardens to plantations and to wild coconut groves in habited and uninhabited islands of Lakshadweep, Andaman and Nicobar. Planting densities vary from wide spacing of 150 palms per ha in some parts of Karnataka to high-density stands of nearly 400 palms per ha in the Lakshadweep islands. The country's coconut cultivation suffers from two main problems: Root (wilt) disease (in Kerala) and moisture deficit conditions, as the crop is mainly grown as a rain-fed crop or with limited irrigation in most growing regions. In addition to the major pests such as rhinoceros beetle, red palm weevil, leaf caterpillar, emerging pests such as Eriophyid mite and rugose spiralling whitefly has become a serious threat to coconut cultivation in recent years. Price fluctuation and varied demand for coconut and its products is also another threat to coconut farmers.

India has a well-developed coconut Research and Development network among the coconut growing countries. The ICAR-Central Plantations Crops Research Institute (CPCRI) and many State Agricultural Universities concentrate on research at the national and regional levels. An All India Coordinated Research Project on Palms (AICRPP) at ICAR-CPCRI plays a crucial role in networking these organizations and facilitates the development of location specific technologies and validation of proven technologies. Genetic enhancement for crop productivity is an important activity of the participating research organizations, particularly by the CPCRI, which spearheads coconut research and development in the country.

A regular bearing, high yielding Micro Tall from Minicoy Island

Coconut populations have two distinct types called 'Tall' and 'Dwarf' in which the accessions belonging to the former type are predominantly used for copra or kernel production and the latter type is used for tender coconut purpose. There are general traits clearly distinguishing the tall and dwarf types of coconut accessions like dwarfness in terms of stem elongation over the years, number of leaves, size of leaves, flowering duration, colour of fruits, pollination behaviour, tender water quantity and quality, copra quality, level of susceptibility to biotic and abiotic stress, adaptability to growing environment and so on. Among the tall accessions, several selections have been made, released as varieties or used as parents in hybrid development programmes along with dwarf accessions. The tall accessions have wide range of diversity for most nut component traits as primarily they are cross pollinated. Among the tall populations, mostly the selections were made and released for medium to large fruit size, high copra content and ease

of cultivation. However, desirable traits existing in smaller fruited coconut types generally called 'Micro' talls. In every coconut population around the coconut growing countries, the coconut breeders have recognized the major types as palms producing large sized fruits, medium sized fruits, smaller sized fruits and micro types. Some examples are Laccadive Micro, Andaman Micro, Coconino (Philippines), Laccadive mini micro, Ayiramkachi (literally meaning "thousand (fruits) setter,"(landraces). There are more such forms especially in the Indian and western Pacific ocean islands this forms may have an evolutionary relevance.

India has conserved about 450 diverse accessions of coconut which includes talls, dwarfs, semi-talls in well established field gene banks at ICAR-CPCRI. The Institute also hosts the International Coconut Gene Bank for South Asia and Middle East. The collections vary for yield, growth traits, morphological and reproductive traits. Among these diverse accessions, micro talls are considered unique for their specific traits such as smaller fruit size, ease of ball copra production, high fruit yield, high copra out turn, tolerance to abiotic stress etc. Micro fruited Indian coconut types have been collected / reported from Lakshadweep Islands, Andaman Islands, Nicobar Islands, Tamil Nadu, Andhra Pradesh and Kerala. Among these collections, the Laccadive Micro Tall accession has been conserved in different countries provided by CPCRI whereas the other micro types are under various levels of conservation, evaluation and utilization in crop improvement programmes. In this article, information on the micro coconut types of India and their potential use in cultivation and crop improvement programmes are briefed.

Large number of female flowers per bunch in Micro Talls

Laccadive Micro Tall (LMT)

The terms Laccadives and Lakshadweep refer to the Indian archipelago in Arabian sea located about 100 km west of the India mainland, consisting of 36 coral islands covering 12 atolls, three reefs and submerged sand banks of which only 11 islands are inhabited. Laccadive Micro Tall was first introduced from the Laccadive Islands to the Indian mainland during 1940 subsequently planted in a replicated trial during 1972 at Kasaragod. It was also exported to Marc Delorme Station, Côte d'Ivoire in 1978. LMT palms are found, though sparsely distributed, in Androth, Amini, Agathi, Kadmat, Kavaratty, Kilt an, Alpena and Minicoy Islands of Lakshadweep. Lakshadweep Islands rank first among the Indian states and union territories in coconut productivity in terms of number of nuts per hectare area, indicating the potential existing in the native coconut population in these islands.

High yielding LMT showing alternate bearing trait

The coconut population of Lakshadweep Islands consists of palms with large- to medium-sized nuts (commonly known as Lakshadweep Ordinary Talls) and small nuts (Micro Talls). The Laccadive Ordinary Tall is the widely cultivated type, while the Laccadive Micro type is found sporadically amidst the Laccadive Tall populations. LMT palms are distributed among the dominant Laccadive Ordinary palms, which are also freely out crossing, resulting in intermixed forms. The LMT, in general, is assumed to possess the inherent variability existing in Laccadive Ordinary tall population with the distinction of producing smaller-sized nuts of varying size and bearing habit. The Laccadive Micro Tall has been identified as the genotype with higher oil content in copra. Among the Micro Talls, the palms exhibit high variability for size, shape of fruits, regular or alternate bearing habit and copra content. The importance of selection among the LMT types was highlighted for successful utilization of this type for desirable traits despite its irregular bearing nature and variation in nut size over seasons as the conserved LMT in the gene bank was reported to be suitable for ball copra production, which is a premium type of copra fetching more price in the market. The low germination rate of LMT nuts under storage makes them suitable for ball copra production. In larger nuts, owing to the larger cavity and high nut water, the germination and subsequent

A high yielding, regular bearing Laccadive Micro Tall crown with cluster bearing bunches

spoilage of kernel during storage was high, whereas in LMT, the germination and spoilage was found to be less.

As per descriptor traits, the stem girth at 1 m height is 83 cm. The palm has a distinct bole. The leaf petiole is long with 232 leaflets, which are 121cm long and 6 cm wide. The palm produces 12 inflorescences in a year. The bunches are heavy with a large number of small and closely packed nuts. The nut is oblong in shape; its colour varies from green to different shades of brown. The occurrence of barren nuts is a character usually associated with this cultivar. Yield and Fruit production generally begins 9 to 10 years after planting. The mean annual bunch production is 11, with a range of 8-12. The average annual yield varies from 100 to 320 fruits per palm in Kasaragod; an average of 106 nuts in Ratnagiri (Maharashtra) and 93 fruits per palm in Veppankulam (Tamil Nadu). Although the nuts are small, the kernel is thick with an average copra content of 90g, with a range of 80-100g per nut. The oil content in copra is 75%, the highest recorded among the cultivars studied so far. Individual palms of LMT from Minicoy were reported to be yielding more than 700 fruits per annum with estimated annual copra out turn of over 50 kg per palm. Hence, variable LMT types in Minicoy Island have potential to be utilized in developing not only superior varieties for ball copra production, but also development of superior genetic stock with more oil and copra output. Due to its high oil content, LMT can be exploited in breeding programmes. This cultivar is being used for the production of Tall x Tall crosses at CPCRI, Kasaragod. At Marc Delorme Station, Côte d'Ivoire, LMT is also crossed with MYD, MRD and CRD, EGD and TAC for the production of Tall x Dwarf hybrids.

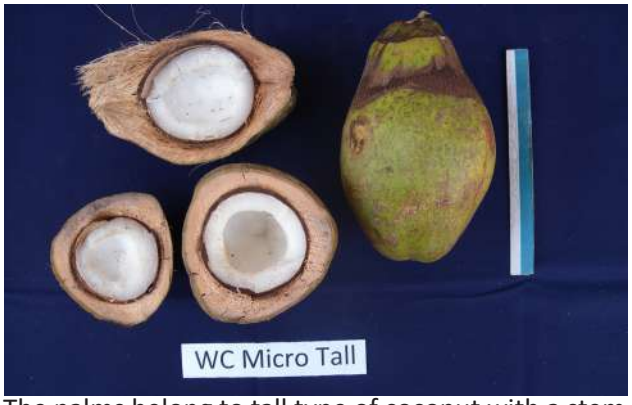
The nuts of Laccadive Micro Tall are ideally suited for the production of ball copra which is considered a special grade of copra and fetches a high price in the market. The small fruits of this variety are traditionally used to make 'ball copra'. To produce ball copra, the husked fruits are placed to dry, usually on the roofs of houses or storage godowns. 8 to 10 months after the storage, the shell is removed to extract the ball shaped copra. The white meat takes on a slightly translucent appearance and becomes rubbery, sweet and scented. The ball copra kernel is mainly used for sweets and confectionary. The palms of Laccadive Micro Tall selection can be grown with the regular recommended package of practices with irrigation for sustained yield of nuts. It can be grown in all coconut growing regions for conservation and further utilization. It has good potential for use in breeding programmes aiming for increasing the nut yield, oil content and more copra out turn.

Ayiramkachi Tall

Ayiramkachi, is a micro tall type palm found in the east coast coconut population of Tamil Nadu, India. Palms of this type produce very small fruits and the fruit shape is mostly oblong, rarely round unlike LMT where one can found all the shapes. The vernacular name 'Ayiramkacki' is based on the fact that the inflorescence bears thousands of female flowers ('ayiram' meaning thousand in the Tamil language). The nuts are green/ brown to greenish yellow coloured and the copra is of good quality. The important character of this variety is high female flower production but fruit setting is low and the palms are mostly alternate bearers. Considering the stem height at different ages, this cultivar is considered as intermediate between Talls and Dwarfs for most characters. The leaves are medium-sized with broad leaflets and strong petioles. The palm starts flowering about six years after planting. The inflorescences are not very long but have more spikelets per inflorescence. Spikelets bear at least one female flower and therefore, the number of female flowers per inflorescence is high (24-46). Fruit set is around 41%. The fruits are small and oblong with thick kernel and shell; this is mainly used for 'ball' copra. The copra content ranged from 50g to 85g in typical palms of Ayiramkachi and the nut production varies from 150 to 400 per palm per year.

West Coast Micro Tall

West Coast Micro Tall is a unique coconut type developed through selection from the population of West Coast Tall conserved at National Gene Bank at CPCRI. The palms in the gene bank were developed through *inter se mating* of WCT mother palms at CPCRI, Kasaragod followed by seedling selection and planting at CPCRI Research Centre, Kidu. The palms of this type are characterized with smaller nuts in large number in a bunch, cluster bearing habit. The accession has scientific value as it has potential for use as parent in hybrid development programmes.



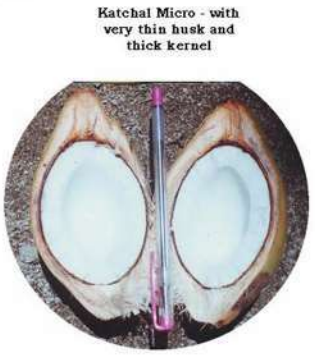
The palms belong to tall type of coconut with a stem girth of 95 cm at 1m height and an average leaf length of 4.3m at the age of thirty. The number of fruits per bunch was observed to be ranged from 40 to 67, the fruits are smaller with fruit length of about 19 cm and fruit breadth of about 12cm. The average fresh fruit weight is about 67g with endosperm thickness of about 1.5cm and the endosperm content is about 190g yielding about 90g copra. The central cavity in the nuts are about 65 ml and the fruit bunches are observed with upto 60 fruits per bunch.

The palms of West Coast Micro Tall are normal in all other morphological traits similar to other coconut accessions. They can be grown with the regular recommended package of practices with summer irrigation for sustained yield. It can be grown in all coconut growing regions for conservation and further utilization.

Micro Tall types of Andaman and Nicobar Islands

Micro tall types are sporadically found among Andaman and Nicobar coconut populations characterized with large bole on stems, longer leaves, longer inflorescences, large number of female flowers, high fruit setting, round to oblong to oval shaped fruits, fruit colour ranging from green to brown or orange shades. Important features of the Micro Talls from Nicobar are the thin husk (0.5 to

Micro Tall from conserved WCT population Crown view and fruit traits



1.2 cm) in matured fruits and the thick kernel (1.1 to 1.4 cm). The *in situ* observations on copra content in Katchal Micro ranged from 85 to 112 g. Unlike Lakshadweep, these micro talls are not preferred much in Nicobar region although few individuals opine good about the Micro tall for their tasty tender coconuts and kernel quality. Our *in situ* observations on Micro Tall of Champin of Nancowrie Island showed the kernel thickness and husk thickness as very promising. The number of fruits per bunch ranged from 85 to 200 and the total number of bunches with set fruits over the crown was 16. The number of leaves on the crown was 42. The thin husked trait and thick kernel traits could be very well utilized in crop improvement efforts towards development of processable coconut varieties. However, unlike Micro talls from Lakshadweep, these Micro produce copra oil content of normal range (59 to 65%). The tender nuts from the Champin Micro and Katchal Micro were categorized as very good for taste of nut water and tender endosperm.

Characterization and evaluation of conserved coconut germplasm in the National Field Gene bank at CPCRI revealed the superiority of the Katchal Micro Tall accession. The early yield showed KMT with the nut production of over 120 per bunch with

Micro type from Car Nicobar with micro and medium sized fruits on alternate years

A bunch from a young palm of Champin Micro Tall at conservatory

Seedling of LMT at Kasaragod

copra content of 92g. This accession was observed as on par with Champin Micro Tall for nuts and copra which has recorded 125 nuts per bunch with copra of 111g. These promising micro accessions are under further evaluation.

Few palms of Champin Micro and Katchal Micro tall show characteristic sharp beak at the distal end of fruits at younger stage. While harvesting the tender nuts, this trait is very helpful as tender fruits could be dropped to pierce the soil thereby reducing the damage to nuts. The beaked fruit trait found in the Nicobar coconut population naturally helps the fallen nuts to get good grip on the surface aiding in good germination and establishment. The farmers believe that the palms under water logged or marshy areas tend to produce beaked fruits.

Another group of very high yielding micro types are found in Car Nicobar wherein the palms produce micro nuts and slightly bigger nuts during alternate years. This type has been collected and conserved for further exploitation. *In situ* observations of this type revealed several desirable traits. The number of bunches over the crown ranged from 9 to 14 with average number of 62 fruits per bunch with kernel weight ranging from 190 to 360g. Here too, the husk thickness was found to be lesser ranging from 1. 2 to 1.8 cm.

Mother palms and Planting material

The distinct traits of almost all the micro types are very high in the number of female flowers per bunch, smaller sized fruits, more number of leaves on the crown, sweet water, thick kernel, thin shell, high oil content in copra, thin husk and very less matured nut water. In Lakshadweep, since the proportion of LMT palms are relatively higher (14% in Minicoy), the copra from these islands are believed to yield more oil. To use the micro talls effectively, production of quality planting material is important. However, selection of mother palms and seedlings is a challenge as the micro talls are highly variable and cross pollinated. A mother garden comprising of typical palms of LMT was established at Minicoy Island by CPCRI which has shown the possibility of selection and augmentation of micro talls. Studies showed that the micro tall types takes longer duration for initiation of germination probably due to less nut water and tough husk layer. However, the seedlings are of high quality, meeting the seedling standards in 12 months. This late germination or less germination trait makes the most micro types suitable for ball copra production. Use of quality seedlings from tested and selected mother palms of micro talls are to be used to get a high yielding, better performing micro tall progenies.

Conclusion

In addition to the above described Micro talls, several other micro types have been collected from different coconut populations of the country and conserved for evaluation and utilization. Micro types have been identified among specific dwarf populations also which needs further studies to establish the stability of selections. So far, the micro type coconuts are mostly seen as a novel type and rarely used for regular cultivation for copra or tender coconut purpose. However, since the smaller nuts are suitable for other purposes such as use in religious functions, production of ball copra, fresh consumption for culinary purpose etc, the micro types have good potential. In the modern era of unit families with less number of family members, the Micro coconuts may get preference over large sized nuts as the whole nuts could be consumed fresh. In crop improvement, generally, the micro type coconut accessions have potential to be used for developing lines for increased copra out turn and oil production. Due to the higher number of nut production, the micro coconut accessions are also used in production of large number of selfed or crossed progenies from selected palms for use in molecular studies to assess the relations among the fruit size, copra content and oil content.

Desiccated Coconut Industry:
the Scenario and Field Level Reflections

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Introduction

To adapt to market fluctuations, the coconut industry must implement strategies such as product diversification and by-product utilization. Recently, India has been actively striving to establish a foothold for its products in the segments of high-value exports. According to the data of Directorate General of Commercial Intelligence and Statistics (DGCIS), value of exports of coconut products (excluding coir and coir products) significantly increased about 10 % from Rs. 3237 crore in 2021- 22 to Rs. 3554 crore in 2022-23. Total exports of coconut and coconut products have increased at a compound annual growth rate of 13 per cent over the last 10 years but with large inter-year variations. India holds an important position in the global exports of activated carbon, which accounted for 66 per cent of total exports of coconut products, followed by coconut oil (12%), copra (4.3%), desiccated coconut (2.3%), and shell charcoal (1.9%). We need to have a practically workable strategy not to lose the existing market share in the traditional markets and aim to access the non-traditional markets with a plausible time frame.

In the domestic front, the consumption pattern of coconut in India reveals that about 30 percent of raw nuts are used for industrial purposes, mainly as desiccated coconut (50%), frozen/grated coconut (38%), and virgin coconut oil (10%). It would be pragmatic to make concerted efforts to increase this utilisation in a phased manner. Even a target of a two percent increase in a span of five years would facilitate a vibrant coconut economy, wherein the spread of the increase should be reflected across increased product lines, including desiccated coconut, neera and coconut milk/cream.

Desiccated Coconut Powder (DCP)

Desiccated Coconut Powder (DCP) is the white kernel of the coconut, comminuted and desiccated to a moisture content of less than 3%. It has been widely used in the food industry, especially in

confectionery, puddings, and bakery. Also, it serves as a substitute for fresh coconut gratings. The production process involves the selection of mature nuts (11–12 months), dehusking, deshelling, testa removing (paring or peeling), slicing the kernel and removal of water, washing, blanching using hot water, disintegrating, drying in batch types of semi-automatic tray dryers or fluid bed dryers to bring down the moisture to 3%, cooling the product to room temperature, sieving, grading, and packing in polyethylene-lined craft paper.

In addition to being rich in healthy fats, DCP is a good source of fibre and minerals. Lauric acid, myristic acid, caprylic acid, palmitic acid, oleic acid, linoleic acid, and stearic acid constitute the major fatty acids present in the kernel. It also contains amino acid such as alanine, arginine, aspargine, glutamic acid, glycine, etc.; vitamins such as vitamin C, vitamin B, and vitamin E and minerals like manganese, potassium, phosphorus, sodium, and copper.

Quality standards

There are strict international (ICC) and national (FSSAI, 2021) standards with respect to product definition and quality of DCP. As per the FSSAI, desiccated coconut means the product prepared by (a) peeling, milling, grating, and drying the white kernel obtained from the whole nut of coconut, having reached the appropriate development for processing without oil extraction. (b) processed

in an appropriate manner, undergoing operations such as dehusking, hatcheting, paring, washing, comminuting, drying, and stiffing. (c) described in points (a) and (b), from which oil has been partially extracted by appropriate physical means. FSSAI also mentions the form of DC as powder, flakes, chips, and shreds. The colour of it shall be white to light creamy white, with a pleasant taste and flavour free from rancidity, foreign matter, insects, moulds and rodent contamination. A size-based classification of DC has been prescribed by the APCC (ICC) as follows:

• Extra-fine desiccated coconut - This is grated desiccated coconut of which not less than 90% of the weight shall pass easily through a sieve with square apertures of 0.85 mm, but of which maximum 25% of the weight passes through a sieve of 0.50 mm aperture size.

• (b) Fine desiccated coconut - This is grated desiccated coconut of which not less than 80% of the weight shall pass easily through a sieve of square aperture size of 1.40 mm, but of which maximum 20% of the weight passes through a sieve of 0.71 mm square aperture size.

• (c) Medium desiccated coconut - This is grated desiccated coconut of which not less than 90% of the weight shall pass easily through a sieve of square aperture size of 2.80 mm, but of which maximum 20% of the weight passes through a sieve of 1.40 mm square aperture size.

Unclassified grated desiccated coconut covers all "fancy cuts" or special cuts (i.e. tender or thin flakes, long and thin chips, extra fancy shreds, long shreds, standard shreds, etc.).

Adulteration of DCP with low-fat DC or coconut milk residue (CMR) is an emerging problem in the coconut processing industry. A study by ICAR-CPCRI on spectroscopic (vis-NIR with 350–2500 nm) detection of adulteration in desiccated coconut powder revealed that different levels of adulteration of DC with coconut flour could be successfully traced and identified if the adulterant concentration was more than 10%. Vis-NIR spectroscopy, along with suitable chemometric techniques, has a great potential for rapid measurement of adulteration levels in DCP.

The trade scenario

The desiccated coconut industry in the country is vibrant, wherein the growth rate in exports of the DC powder for the last five years stands at a stupendous

QUALITY OF DESICCATED COCONUT	APCC QUALITY STANDARD FOR DESICCATED COCONUT	FSSAI QUALITY STANDARD FOR DESICCATED COCONUT
Moisture (%)	for standard granular grades : 3.0 (Max)for special cuts : 4.5 (Max)	3 (Max)
Free Fatty Acid as lauric (%)	0.15 - 0.30	0.3 (Max)
Oil Content (%)	Not less than 60%* (*less than 60% will be classified as low fat desiccated coconut)	without oil extraction as described in (a): 60 (Min)
		For partial oil extraction as described in (c) : 35- 60
Total ash (%) (Max)		2.5
Extraneous vegetable materials, fragments etc.	The extraneous vegetable matter consisting exclusively of fragments of shell, fibre, peel and burnt particles shall not exceed 15 fragments per 100 g	15 per 100 g (Max)
Foreign matter		Absent in 100 g
Food Additives (Sulphur Dioxide)	< 200mg/kg	Product may contain food additives permitted in Appendix A of FSSAI standard regulation, 2011
(SO2 Max of 50 g per kg)		
Contaminants	Desiccated coconut shall be free from heavy metals in amounts which may represent a hazard to health and shall comply with those maximum levels established by the CODEX ALIMENTARIUS COMMISSION	
Micro biological Standards	The microbial count shall not exceed the following limits: Salmonella: Negative in 25 gram Total Plate Count : 5,000 cfu/gram Coliform group count: <50 cfu/gram Yeast: 100 cfu/gram Molds :100 cfu/gram *E.coli* : <3mpn/g (Not detected)	

26.8 %. The Europe and USA together account for 72 % import share of the DC powder in the world, and in the recent times, due to stringent food safety norms in these countries, the consignment rejections of the products from the Philippines and Indonesia (the major exporters). In this scenario, there exists a huge potential for India to increase the global market share of DC by ensuring the stipulated quality and safety requirements of the products for the high-value market. India's key export destinations for desiccated coconut in 2022-23 were UAE (18.7%), Iraq (11.3%) and USA (9%).It is imperative to chalk out and implement a plausible export promotion strategy to selected markets with selected commodities wherein India has a comparative advantage. The potential of products such as DC powder as an export earner is true, and to have premium access in the high-value markets of the EU and USA, we need to take utmost care in positioning the DC powder from our country as a super-food complied with all food safety standards.

The desiccated coconut sector in India was severely affected by the import of cheaper coconut from Sri Lanka, which entered the country, duty-free under the SAFTA agreement. In January 2020, the import policy for desiccated coconut was changed to safeguard local growers from low-cost imports from Sri Lanka. Imports of desiccated coconut valued below Rs. 150 per kilogram were categorized as 'Prohibited'. Consequently, the import of desiccated coconut declined from 17.9 thousand tonnes in 2019-20, to 4.8 thousand tonnes in 2022-23. Further cause for apprehension is the import of oil cake, as defatted desiccated coconut, which is blended with high-quality desiccated coconut manufactured domestically and sold at a reduced price. It is noteworthy that the import duty of copra meal is 15 per cent, while the import duty of DC powder is 70 per cent. The current practice is adversely impacting the desiccated coconut business, thereby necessitating a specific policy revision.

Vittal Balaji Desiccated Coconut Powder - The saga of a DC Enterprise from Kasaragod, Kerala

Vittal Agro Industries is one of the major Desiccated Coconut Powder (DCP) enterprise in India. The DCP unit was established in 2008 with technology and financial support from Coconut Development Board. The unit is located at Thattummal in Kodom-Belur gramapanchayat of Kasaragod district in Kerala.

"Our locality is having large number of coconut orchards and our district is a major producer of coconut in the state. But there was no coconut processing initiative to utilise the locally available coconut to produce and market value added products like DCP. In fact a sizeable quantity of coconuts were being sold to the DCP units located at Tiptur in Karnataka. That is why we thought of establishing a DCP unit in our locality. We were already having experience in agro-processing sector and were having two cashew factories in the district. Moreover, traditionally we were having the family business of commodity trade dealing with diverse produce including cashew nut, arecanut, spices etc ". Mr. Guruprasad, one of the partners of Vittal Agro products explained why they ventured into DCP production and marketing enterpise. Mr. Guruprasad is also the President of the All India Desiccated Coconut Powder Manufacturers Association.

The DCP unit when started in 2008 with an investment of three and half crore rupees was having per day processing capacity of 8000 nuts. Subsequently in 2018-19 the unit was expanded with a processing capacity of 2 lakh coconuts per day. Besides enhancing the processing capacity, higher level of automation of processing was also aimed while expansion of the processing unit was carried out. However, few difficulties including malfunctioing of the coconut water extractor unit and testa removing unit didn't allow the factory to fully realise the potential of desired level of automation. Mr Guruprasad was a bit apprehensive about the scheme on providing incentive for coconut processing enterprises. He told that though the expansion drive needed a huge investment, the enterprise didn't get financial support for the same from the relevant agencies.

Availability of coconuts for the DCP factory is not a problem; it is available locally, within 50 km radius from the factory. The unit procure coconuts from about 60 retail traders. Besides, some coconut farmers directly sell coconuts to the factory. Nuts are also procured from places like Kuttyadi in Kozhikode district and Perinthalmanna in Malappuram district.

The stipulated quality control protocol is being strictly adhered to at every stage of production process of DCP in the factory and the enterprise having the brand name 'Vittal Balaji Desiccated Coconut Powder' has earned the credibility as the supplier of quality DCP. In the domestic market the Vittal Agro Industries supply DCP to big companies like Britannia, Parle and ITC besides supplying to many other stakeholders. Export of DCP is mainly to Middle East and African countries.

"We never compromise on quality of DCP and are able to produce and supply DCP as per the quality standards prescribed by the buyer companies" ; Mr Guruprasad added.

Currently the factory employs about 250 workers. About 30 per cent of them are from the nearby localities and the remaining are from Karnataka and Bihar. Workers from Karnataka, especially women, are engaged in the skilled work of testa removing

and the workforce from Bihar are skillful at breaking and removing coconut shell.

Besides DCP, the factory also produces and market coconut flakes and supplies it mainly to Agrotech Foods Ltd (ATFL) who makes 'Sun Drop - Duo Coconut'Choclate. About 40 tonnes of coconut flakes are produced in the factory per month.

Presently the coconut shell, the byproduct from the DCP fatcory is sold to coconut charcoal units. The parings (testa removed from the kernel) are collected separately, dried and used to produce coconut oil in a leased coconut oil mill located at Trikaripur. Coconut water, another byproduct was earlier sold to Cavin Care, Tirupur. Since presently the firm is not procuring it from the factory, establishing units for preparation of vinegar or beverages using coconut water is being contemplated.

Mr. Guruprasad also described the constraints to run the enterprise. "The most important constraint we experience is in the field of marketing. The cheaper brands of DCP which do not conform to the quality standards flood the market and it is tough to compete with them. The unscrupulous elements utilise materials being imported from countries like SriLanka as 'Defatted coconut' to adulterate DCP which are sold at cheaper rates. This kind of shady deals are to be strictly dealt with and the relevant government agencies need to act tough and apply the regulatory mechanisms more effectively to detect and curb the adulteration practices which adversely affect the coconut industry in the country" Mr. Guruprasad opined.

Though problems are there, especially related to marketing, Vittal Agro Industries plans to go for further diversification of coconut value added products. According to Mr. Guruprasad, they target to establish units for production and marketing of coconut milk and virgin coconut oil soon.

Summing Up

Despite being the foremost producer of coconut globally, India's export performance remains significantly below its potential owing to disadvantages arising from price competitiveness. Thus, to reap the benefits of export and achieve its potential, a focused export strategy needs to be framed, encompassing all the exportable products of coconut and giving adequate thrust to value addition and product diversification. In the case of the Desiccated Coconut Sector, which is indubitably a sunrise industry, a multi-pronged approach is essential to keep the sector buoyant and thriving. On the one hand, in the domestic market, the ever-surging confectionery industry, which is growing at an annual growth rate of 20%, is a promising factor, and on the other hand, the impressive growth in the world market provides an optimistic outlook. Having said that, it is crucial to formulate an actionable strategic framework and implement it in a time-bound manner to capture the domestic market. The international market is more challenging as food safety standards are proliferating and price competition is fierce among the competing countries to grab market access. In this scenario, we need to pay utmost attention to each node of the DC value chain, from production to the domestic/overseas market, wherein the (stakeholders) at each node are guaranteed optimal value sharing and profit accumulation. The specific issues pertaining to the DC manufacturers need to be critically addressed to formulate rational solutions.

Farmers' Seminar and Coconut Seedling Distribution

CDB, Regional Office, Patna participated in the 'Farmers' Seminar and Coconut Seedling Distribution organised by the Shaheed Amit Memorial Centre, Mahmada, Pusa, Samastipur, Bihar at Samastipur, Bihar from 27th to 28th November 2023. Dr. P.S. Pandey, Vice Chancellor, Dr. Rajendra Prasad Central Agricultural University inaugurated the programme. He also planted a coconut seedling in the premises of Shaheed Amit Memorial Centre. The Seminar discussed the possibilities of finding solutions to the different problems faced by the horticultural farmers. The farmers were made aware of the importance of soil testing so as to increase the productivity of their crops. Dr. H P Singh, former Horticulture Commissioner cum former Chairman, Coconut Development Board attended the seminar along with other dignitaries and scientists. Shri Rajeev Bhushan Prasad, Director (Dev), Regional Office, Patna and Ms. Vinita Kumari, Technical Officer, CDB represented the Board in the seminar. Shri Rajeev Bhushan Prasad, in his address encouraged the farmers to practice scientific method of coconut cultivation He briefed on planting, irrigation, and other management practices for coconut cultivation . Around 200 farmers and visitors attended the programme.

Coconut tissue culture - Status of research work and concerns of farming community

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The coconut palm (*Cocos nucifera L.*) is a tropical perennial multi-purpose tree that offers a wide variety of products with domestic and industrial applications. The average productivity of high-yielding varieties released from research institutes in India ranges from 17,000 to 24,000 nut ha. But average annual productivity in India hovers around 9000-9500 nut ha. The supply of quality planting material to various stakeholders alone can result in 50% increased productivity. Coconut is exclusively propagated via seeds and planting materials produced via these conventional techniques are insufficient to meet the demand for quality seedlings. The development of a mass multiplication protocol has always been a focus area of coconut research for large-scale production of seedlings with high yield and resistance to biotic and abiotic stresses. Generally, there are two pathways of *in vitro* regeneration of plants: somatic embryogenesis and direct organogenesis.

Somatic embryogenesis

Somatic embryogenesis (SE) has been identified by many researchers as the most feasible technique for the large-scale production of high-quality coconut plantlets. Coconut SE involves, the induction of embryogenic calli, the formation and development of the somatic embryos, their maturation, then germination, and finally, the recovery of the plantlet formed. At every stage in the SE approach, from somatic cells to whole plantlet formation, numerous factors have been found to play crucial roles in its success, including the genotype of the donor plant, the explant type, the media and plant growth regulators (PGR) used, and the acclimatisation procedures. Several coconut tissues have been used for explants, viz., shoot tips, plumules, rachillae sections, young leaves, unfertilised ovaries, and immature embryos, with the response varying depending on the explant type. Successful regeneration from plumular tissues through somatic embryogenesis pathways has been reported in various countries, including India. Regeneration from immature inflorescence has also been reported in Mexico. In Sri Lanka, unfertilised ovaries have been reported as successful explants for the multiplication of elite coconut palms.

Direct organogenesis

Over the past 60 years, SE was generally considered the only biotechnology to produce clonal coconut palms. However, direct organogenesis could be an alternative pathway for the clonal propagation of coconut. It involves the formation of shoots directly from the tissue without an intermediary callus phase; therefore, the risk of somaclonal variations is lower. The organogenesis protocol consists of the following steps: initiation of meristematic buds, multiplication, shoot elongation, rooting and plant acclimatisation. Successful regeneration of plantlets from rachillae bits via direct organogenesis has been reported in India. Recently, researchers from Belgium have reported a novel axillary shoot multiplication protocol capable of large-scale multiplication of coconut palms. Slicing of zygotic embryos and shoot tips for the regeneration of plantlets has been demonstrated successfully by researchers from Tamil Nadu Agricultural University.

It is evident from the above description that various explants have been attempted (viz., leaves, inflorescence, plumular tissues, ovaries, anthers, roots, and embryos coconut tissue culture) by different labs for standardising the protocol for *in vitro* propagation of coconut. However, researchers have recorded poor response to *in vitro* interventions irrespective of the type of explants, cultivars or culture conditions. Several reasons have been attributed to the *in vitro* recalcitrance viz., genotype effect, collecting explants of specified maturity level, adsorption of nutrients and hormones by activated charcoal, which makes the culture conditions undefined, low percentage of somatic embryogenesis and plantlet regeneration, slow growth of regenerated plantlets and difficulty in rooting. All these factors could have cumulative effects in imparting poor *in vitro* responses. Overcoming these barriers is essential for efficient

large-scale multiplication for meeting the demand for quality coconut seedlings.

Among the different explants, the most extensively studied are the zygotic embryo and immature inflorescence, which have responded positively to *in vitro* conditions. Several researchers have tested zygotic tissues such as immature embryo and plumules (the shoot apex excised from zygotic embryos) for *in vitro* plant regeneration. The responses of these tissues have shown to be better than those of vegetative tissues in terms of callus formation and embryogenic capacity. The major disadvantage in using these explants is that, unlike somatic tissues, zygotic tissue produces clones with uncertain pedigree and performance. This drawback can be attributed to the heterozygous and cross-pollinated nature of coconut. However, it is important to point out that plumular explants can be used for mass propagation of self-pollinated, dwarf varieties of coconut. It is evident that zygotic tissues are not the ideal explant for clonal propagation since they produce clones with unknown performance. This constraint is particularly relevant with respect to high-yielding hybrid coconuts, as their plumules cannot be used as explants due to the nature of segregation, which can be observed in the progenies raised from the hybrids.

To produce true-to-type progenies, we need to use somatic tissues as explants from a palm that has proved its performance. Using floral tissues as an explant could be the best option, considering its high response under *in vitro* conditions. For instance, rachilla explants from immature inflorescence or unfertilised ovary are promising explants for clonal propagation of elite palms of known performance with good agronomic traits (high yield and disease resistance). Using immature inflorescence culture has recently emerged as a promising technique for mass multiplication of elite coconut genotypes. Immature inflorescences are abundant in meristematic points, making them an excellent source of explants. The success of regeneration depends on selecting immature inflorescences at the appropriate maturity stage. Unfertilised ovaries have been used as another novel explant type for coconut somatic embryogenesis, particularly as somatic tissues could produce true-to-type plantlets from all coconut varieties. However, it is challenging to use these types of coconut tissues. For example, the correct age of the inflorescence tissue to be used as an explant can be difficult to determine and harvesting this material is destructive, if not fatal, to the palm.

Other *in vitro* techniques for the propagation of coconut

Embryo culture

The protocol for embryo culture developed at ICAR-CPCRI has successfully been used in germplasm expeditions since the early 2000's. Another important application of embryo culture is in the germplasm collection and exchange. Collecting and exchanging coconut germplasm is difficult and not economical because of the short dormancy and bulkiness of the seed, resulting in seed germination when stored for more time in a germplasm expedition. Moreover, phytosanitary restrictions also limit the germplasm introduction. Standardisation of the embryo culture technique provides an easy and safe alternative for the movement of coconut germplasm and is emphasised in the technical guidelines of FAO/IPGRI. Coconut germplasm exchange by seeds has been gradually replaced in recent years by the culture of zygotic embryos due to several factors, such as the high cost of transportation due to the size of seeds, the risk of germination during transportation, and the potential introduction of pests and diseases.

Embryo rescue

Embryo rescue is an effective technique for obtaining plantlets *in vitro* from embryos which either fail to germinate in nature or exhibit delayed germination. Mohachao Narel is a coconut variant reported from Ratnagiri district of Maharashtra State in India, which is characterised by a sweet and soft kernel and less fibre content. The embryo weight of sweet endosperm nuts was recorded to be significantly lower than nuts possessing normal endosperm, which hinders its germination under natural conditions. Embryos from sweet kernelled nuts were 'rescued' via embryo rescue, and plantlets could be regenerated successfully through ICAR-CPCRI embryo culture protocol.

Are coconut tissue culture plants available for commercial cultivation?

Currently, coconut tissue culture plantlets are unavailable for sale to the general public. The tissue culture plantlets produced at research institutes like ICAR-CPCRI and TNAU are being evaluated at research stations.

Whether tissue culture coconut plantlet will be a super palm?

Tissue culture is a clonal propagation technique, meaning that the performance of the tissue culture

palms would be true-to-type to mother palms. Suppose the mother palm is superior in terms of yield or disease resistance, in that case, the tissue culture technique will result in the production of plantlets having similar performance and with the same genetic makeup as that of the parental palm. This is an advantage of tissue culture plantlets, as it is practically unattainable to produce true-to-type plants through conventional seed propagation techniques.

Will the tissue culture plants be uniform with respect to their yield performance and other traits?

All plantlets produced from an explant are supposed to be uniform as they have the same genetic makeup.

Is it true that tissue culture plants come to flowering early?

It is reported that from the field trials conducted with SE-derived plantlets, performance is determined to be good, including growth and development to the fruit-bearing stage. These SE-cloned plants started bearing fruits about six months earlier than plants produced from seed.

It should also be noted that the juvenile phase of coconut palms is influenced by genotype and growing conditions and largely by the environment.

Information regarding the longevity of tissue culture-raised seedlings

Since the research on tissue culture plantlets is still in infancy, it is quite early to give an opinion regarding longevity. Only a few labs in the world have successfully produced tissue culture seedlings, and that too in small numbers.

Approximate cost of production of each tissue culture coconut seedling

At present, the cost of production of tissue culture seedlings is very high because the technology is capital, labour and energy intensive. A major part of the cost is for maintaining the electrical requirements, as the plantlets will be maintained under controlled temperature and light conditions throughout. Labour requirement is another factor contributing to the high cost of production. The use of bioreactor technology involves *in vitro* culture of cells, tissues and organs in a liquid medium and in an automated system. This system allows a reduction of labour and production costs. Compared to conventional systems with semi-solid agar medium, it is a faster and more efficient technique for the large-scale, *in vitro* propagation of plantlets. In addition to reducing labour and production costs, other advantages of bioreactors include less space required for production, better plant quality and vigour, increased productivity and overall efficiency.

What are the main advantages of tissue culture seedlings?

True-to-type nature and uniformity of plantlets, potential for large-scale multiplication of high-yielding elite parental palms, traceability of the pedigree of the plantlets, offers scope for production of genome-edited and genetically modified coconut palms with specific traits (drought tolerance, disease resistance, etc.)

Whether the roots of tissue culture plantlets can provide anchorage to the palm?

The root system of coconut is known as fibrous or adventitious, and it consists of an abundance of thin roots that develop from the stem's base. Only a few of the roots penetrate deep into the soil for anchorage. So, the adventitious root produced from *in vitro* raised plantlets is also expected to provide good anchorage.

Conclusion

Plumular tissues are the preferred explant type for large-scale production of dwarf coconut types. In contrast, somatic tissues, such as ovaries and young inflorescence tissues, enable the production of true-to-type clones from tall and hybrid coconut types. A novel micropropagation method was reported from Katholieke Universiteit (KU), Belgium, based on axillary shoot formation. Reports of successful coconut micro-propagation using plumule and floral explants have also been reported from CICY, Mexico, in collaboration with Wye College (UK) and ORSTOM-CIRAD (France). Long-term field trials related to evaluating the performance of tissue culture plantlets are not available from any research institute. Considering the benefits to the farming community, it is suggested to strengthen the work carried out in different labs across the world to standardise a repeatable protocol of *in vitro* propagation of coconut.

KLF: Cultivating Success Across Generations - a Pioneering Legacy in Coconut Processing

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KLF, a name synonymous with excellence, has been crafting its own coconut success story for years. The essence of this achievement becomes apparent when one steps into KLF's state-of-the-art factories, strategically located amidst the lush greenery of Irinjalakuda in Thrissur District, Kerala, and Perundurai in Erode District, Tamil Nadu, established by the visionary businessman, the late Shri. K.L. Francis, who was instrumental in promoting KPL Oil Mills in Irinjalakuda and the founding of KSE Limited, the largest-selling cattle feed company in the country. Presently, the third-generation entrepreneurs at the helm continue to shape KLF's trajectory in the coconut oil and derivatives industry, providing employment opportunities to over 1,000 individuals directly and through contracts.

KLF is having the broadest range of coconut and derivative products in the industry, spanning both traditional and non-traditional products. The diverse product portfolio includes traditional coconut oil for cooking and hair care, various grades of virgin coconut oil, coconut milk powder, coconut milk products, coconut-based vinegar, instant masalas, ready-to-cook sweet dish mixes, bakery items, and upcoming products such as coconut chips, coconut concentrate, coconut syrup, and nata de coco. The brand also extends to coconut sugar, coconut soaps, and many more products.

Commitment to Consistency and Quality

KLF upholds the principles set by Shri. K.L. Francis in copra buying and milling, serving as a contemporary exemplar for the industry. The company's innovative copra buying procedures and advanced milling and filtering processes ensure the production of high-quality coconut oil that meets both Indian and international standards. The company is procuring coconuts and copra primarily from individuals and traders, and these procurement centers serve as vital hubs for obtaining the finest copra. KLF's commitment to supporting local farmers and individuals is evident through their straightforward and efficient procurement process. Transactions at these centers are done on a ready cash basis, facilitating swift and seamless transactions for small-

KLF Irinjalakuda factory, Kerala

scale farmers and individuals alike. This approach not only streamlines the supply chain but also ensures that those contributing to KLF's success are promptly compensated for their valuable contributions.

Brands - KLF Nirmal and KLF Coconad

KLF is having two brand names, KLF Coconad and KLF Nirmal, which are popular not only in Kerala but also across Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Orissa, Madhya Pradesh, and Chhattisgarh. Beyond the borders of India, KLF's reputation reaches far into Middle Eastern countries, including the U.A.E., Bahrain, Qatar, Kuwait, Oman, and Saudi Arab.

The assurance of quality is actually a verifiable reality, as underscored by KLF's adherence to the most rigorous industry standards. Holding prestigious certifications such as ISO 22000, BRC Certificates, and ISO 14001, KLF ensures that its products consistently meet and exceed stringent benchmarks for quality and environmental responsibility. The unwavering commitment to 100% purity and quality is the basis of KLF's dedication in offering an unequivocal guarantee of complete customer satisfaction.

Within the domain of coconut oil, KLF operates in the Edible and Hair Care segments. Coconad stands as the distinguished brand name for the edible category, symbolizing culinary excellence and nutritional goodness. Meanwhile, Nirmal is a brand dedicated to hair care products, showcasing KLF's dedication to personal care. This segmentation reflects KLF's approach to meeting diverse consumer needs, ensuring that each product, whether for consumption or personal care, upholds the same uncompromising standards of purity, quality, and customer satisfaction.

KLF Perundurai factory, Tamil Nadu

KLF Nirmal is expeller-pressed coconut oil for hair care, representing the oldest and most widely distributed brand within the KLF portfolio. With its unique sweet aroma, KLF Nirmal holds a significant position in the industry. KLF Nirmal was the leader in introducing branded coconut oil in a transparent pack, a testament to its commitment to transparency and quality. The brand's purchasing, processing, and manufacturing systems have evolved over years of expertise, ensuring a consistent supply of premium coconut oil. With its two modern, fully automated manufacturing units, a specially designed processing technology minimizes residual moisture even in fully dried copra. Following extraction, a rigorous four-stage filtering process enhances crystal clarity, doubling the shelf life and amplifying the aroma of KLF Nirmal coconut oil.

KLF's adoption of cutting-edge technologies positions it as an innovative leader, showcasing the transformative potential of integrating technology into traditional industries. With an illustrious history spanning more than 80 years in the edible oil industry, KLF Nirmal ranks among the top-selling coconut oil brands in the country.

The brand extends its influence through one of the country's largest in-house cold press facilities, dedicated to producing virgin coconut oil. Positioned as a multi-benefit oil for skin, hair, and health, KLF Nirmal virgin coconut oil is clinically proven effective on baby skin, particularly against diaper rash. The brand further expands its offering with KLF Nirmal baby oil, an extension of cold-pressed virgin coconut oil designed in a baby-friendly pack with colors directly appealing to its target audience.

KLF Coconad is exclusively using Sulphur Smoke Free Copra. Sulphur Free Copra is sourced from farmers through collection centres spread across Kerala. Also in their Tamilnadu Factory KLF is converting in house, around 1.5 Lakhs coconuts per day to copra. Thus ensuring Sulphur Smoke Free Copra's availability.


In a strategic move, KLF revamped its product portfolio, introducing COCONAD, a new edible coconut oil brand with Padmashri Bharat Mohanlal as the brand ambassador.

The triumph of Coconad coconut oil inspired KLF to venture into coconut milk and coconut milk powder. The unique selling proposition of Coconad coconut milk and coconut milk powder lies in the careful selection of Kerala coconuts, with its special sweet taste and aroma appreciated by consumers. Rigorous research ensures that the physical characteristics and quality parameters align with consumer perceptions, positioning KLF Coconad in the healthy and tasty platform. Under this umbrella brand, KLF has introduced a range of value-added products from coconut, emphasizing both health and taste for the discerning consumer.

Innovation in Processing Technologies

KLF's commitment to innovation is evident in its processing technologies. Vacuumized Steam Injected Cooking (VSIC) technology is employed to ensure the purity and hygienic quality of their 100% pure edible oils. This technology not only reduces moisture content but also saves energy, time, and cooking oil costs by 10-15%. KLF's early adoption of cutting-edge technologies positions it as an innovative leader in the industry.

Airport Ventures: Coconut Kiosks at Cochin International Airport

KLF is having two kiosks at Cochin International Airport, strategically positioned in the domestic departure terminal and the international departure terminal, respectively. The domestic departure terminal outlet has been in operation since 2020, while the international departure terminal kiosk was

Airport kiosks in Cochin International Airport (Domestic as well as International Departure Terminal) Showcasing Coconut Story

inaugurated in August 2022. These kiosks serve as dynamic showcases, offering the broadest array of coconut-related products for sale.

The outlets play a pivotal role in highlighting the versatility of coconut and extending the narrative to diverse audiences, particularly travelers who can carry the coconut products with them to various destinations. The presence of these kiosks at the airport has proven to be an effective means of reaching a global audience, fostering awareness about the myriad applications of coconut products.

Encouraged by the success of their airport ventures, KLF envisions expanding their footprint to other key locations. The plan includes establishing shops not only in additional airports but also in bustling shopping malls and along national roads. This expansion strategy aligns with KLF's commitment to making their diverse range of coconut products accessible to a wider demographic, ensuring that the coconut story continues to unfold and captivate audiences across varied settings.

Global Presence and Accolades

With a strategic presence with an office in Sharjah Airport Free Zone, KLF has expanded its reach to GCC countries. The company's products, listed in major supermarkets and hypermarkets in the GCC, have earned acclaim, with export turnover reaching around Rs.56 crores. Recognized as a certified Export House, KLF received the Best Coconut Industry Award from the International Coconut Community in 2022, highlighting its continuous efforts to reach international markets.

As KLF Nirmal celebrates its rich legacy, it serves as an inspiration to businesses worldwide. The success story of KLF imparts valuable lessons, emphasizing the enduring impact of unwavering values, innovation, sustainability, and community engagement across generations. With a vision to take the coconut story to the world, KLF remains a pioneer in the coconut processing industry.

Sustainable and Profitable Coconut Based Mixed Cropping through Scientific Soil Management in Southern Midland Laterites

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"Coconut growers are presently experiencing great difficulties due to frequent price fluctuations of coconut in the market. Enhancing productivity through scientific crop management practices, especially soil health management and adoption of coconut based multiple cropping are important strategies to overcome these challenges and make coconut farming sustainable and economically viable" opines Dr. K. Madhusoodanan Nair, former soil scientist who raised a coconut garden replacing rubber, in three and half acre farm land at Palamattom, Karukachal in Kottayam district of Kerala state. 'We need to be innovative to thrive under difficult situations', he adds.

Achievements of Dr. Nair clearly indicate the feasibility of substantially enhancing coconut productivity through alleviation of soil related constraints and increasing income through coconut based mixed cropping systems.

Dr. Nair, a renowned soil scientist, retired from ICAR-National Bureau of Soil Survey and Land Use Planning in 2016, decided to be a fulltime farmer. After removing rubber trees Dr. Nair planted coconut in three and a half acres plot during April/May in the year 2017. His friends and relatives tried to dissuade Dr. Nair when he decided to replace rubber and go for coconut based mixed cropping system. But proved all his critics wrong when he was able to harvest on an average about 100 to 150 nuts per palm per year from his garden which is five times higher than the average coconut productivity in Kottayam, district. It is only six years after planting coconut and it is possible to achieve further increase in yield until the yield of palms get stabilized by about 10 years after planting.

Mostly tall varieties are cultivated in Dr. Nair's plot. Out of the total 250 palms, 150 are West Coast Tall variety. The remaining plams include 50 of Tiptur tall from Karnataka, 25 NCD and 25 TxD. Adoption of scientific crop management practices, especially soil health management, had great beneficial impact on the growth of coconut palms. The palms in the farm

are very healthy and are growing vigorously. Palms are devoid of any symptoms of nutrient deficiency. Dr. Nair is extremely happy these days since at the age of three and half year all tall palms (WCT and TipturTall), except very few, had put out spadices. The tall varieties normally do so after five or six years.

Coconut cultivation in Kottayam district is characterised by severe incidence of the debilitating root (wilt). However, Dr. Nair is able to maintain the coconut palms in his farm free of the disease which he attributes to the scientific crop management practices, especially soil health management. He has evolved a modified package for nutrient management for coconut palm. Various components of the package and the rationale of each is described by him as follows.

The analysis of surface and subsoil samples drawn from the farm were carried out by Dr. Nair in his own laboratory at Bangalore way back in 2015 itself. The results pointed to very strong surface and subsoil acidity, acute deficiency of secondary plant nutrients calcium, magnesium and boron and toxic levels of monomeric aluminium in subsoil solution. Dr. Nair reckoned that amelioration of soil acidity and external inputs of necessary plant nutrients is the key to successful crop production in the impoverished laterite soils of his plot.

Amelioration of soil acidity: After clearing all trees from the plot, 15 tonnes of dolomite ($CaCO_3.MgCO_3$) was broadcast in the entire plot and ploughed in.

Dolomite containing calcium and magnesium was preferred over calcium carbonate, the usual liming mater, since heavy input of calcium can cause magnesium deficiency in soils containing low levels of plant available magnesium. For the same reason magnesium sulphate was used to ameliorate subsoil acidity, instead of gypsum (Calcium sulphate).

Agronomic management of coconut palm: In difference to usual practice, 5x5x5 feet pits were dug and refilled with excavated soil mixed with 50 kg dolomite,upto 3/4th of the pit. Six months old coconut seedlings were planted in May/June of 2017. The pits were gradually filled to field level. The annual practice of making basins around the palm before the onset of monsoon and closing them at cessation of monsoon is not at all practiced in the farm. Basin opening is not necessary in sandy and laterite soils,for water percolation into ground water, which are highly porous and water permeable. Substantial quantum of labour can be saved through avoiding basin opening and closing. Zero tillage is practiced in the farm with soil dug only to plant inter cropped perennials and annuals. Dolomite application is carried out for all intercrops at the time of planting. Coconut palms receive regular mulching with fallen dry fronds, other debris from the palm and glyricidia leaves. The decomposed mulch is the only organic matter inputs for the palms. The dry palm fronds alone contribute around 70 kg organic matter annually. No animal manure is used in the farm. All fertilizer inputs are broadcast around the plam over the mulch. The high intensity rain ensures washing down of the insoluble dolomite and soluble fertilizers into soil. Thus, soil disturbance is totally avoided around the palm. Weed control is achieved through regular mechanical bush/weed cutting and/or chemical weedicides. All the farm wastes are recycled in the farm with no organic inputs into the farm or going out. The larger objective of zero tillage and organic waste recycling is to sequester maximum possible organic carbon into soils and lead to carbon neutral farming.

The farm is fully bench terraced with rock pitched bunds ensuring minimum overland flow of water. The rainwater harvested from roof tops in the farm are collected in storage tanks and ponds. Well water coupled with stored rainwater is used for irrigation coconut palms and intercrops during dry months from January to mid May.

The soil acidity and plant nutrient management isthrough external input of liming materials and chemical fertilizers. The inputsare applied in a circular area, drawn around the palm with radius of two meter. The following is the annual schedule of external inputsfor a three or more years old palm.

1. In mid May, application of 2 kg dolomite per palm.

2. After lapse of two weeks, application of half kg each of urea, factamphos and one kg muriate of potash.

3. After two weeks, application of one kg magnesium sulphate and 100 gm each of borax and zinc sulphate.

4. In October repeat the application of 2 and three as above two weeks apart.

5. Towards end of November (cessation of monsoon) application of two kg common salt.

Periodic price crash/price fluctuations is a major constraint experienced by farmers cultivating perennial crops like coconut. It is practically impossible to frequently shift from one perennial to another with changing markets. Monocropping of coconut can never be a remunerative option, especially in the tiny and fragmented farm holdings as observed in the case of Kerala state. The viable strategy is to adopt crop diversification in farm holdings so that farmer will be protected from the adverse impact of violent price fluctuations. At least one or two crops in the system may have favourable price situation even if other crops in the system may be subjected to the problems due to low price.

Coconut is a perennial crop which is quite amenable for multiple cropping and integrated farming systems. Dr. Nair says that coconut based mixed cropping is a viable option in most agro-ecosystems of Kerala. However, in the light of climatic aberrations and indifferent soil health, it is necessary to enable farmers realise high productivity

and profitability through scientific management of coconut based mixed cropping system, he adds. Selection of component crops should be carefully done taking into account factors like soil health status, growth habit of crops, irrigation requirement, market trends etc.

Right from the beginning Dr. Nair had a clear idea about choice of component crops, both short duration crops and perennials, and their management practices. Currently the component crops in the coconut based inter/mixed cropping system, their management practices and output realised are as follows.

Perennials: Currently the farm has 250 coconut palms, 500 pepper vines, 800 arecanut palms and 500 coffee bushes. No fruit trees are included due to marketing woes.

Annuals: Currently banana, elephant foot yam, Colocasia and turmeric are grown in the garden. The annuals from its peak in initial years have decreased gradually with increase in canopy cover of perinnials. Even after six years, the income from annuals is substantial.

Intercrop management: All the intercrops are managed as per POP recommendations of KAU with subtle modifications necessary for midland laterite soils. It includes application of heavy dose of dolomite for perennials at the time of planting and one kg for annuals. No external input of organic materials like farmyard manure or compost, zero tillage are followed for the entire farm. NPK inputs are provided chemical fertilizers mainly urea, factamphos and muriate of potash. Rock phosphate and bone meal are not used since they are practically non-reactive in limed soils whose pH is above 5.5. Other chemical fertilizers annually used for all crops is magnesium sulphate, borax and zinc sulphate. Magnesium sulphate @250 to 500 g per plant per year is applied to all intercropped perennials and for annuals 150 g per plant. Borax and zinc sulphate are applied @ 50g per plant for perennials and 30 g per plant for annuals.

Challenges

In spite of the success he could achieve in managing the coconut based mixed cropping system, Dr. Nair experiences the threat from two pests, rhinoceros beetle and red palm weevil. Incidence of bud rot disease also is another problem he faced. He says that it is very difficult to effectively manage the menace of the beetle and weevil by adopting the recommended pest management methods.

Insersion of used closely woven, nylon fish nets cut to approximate size of around 2 square feet into the top three frond axils of coconut crown has proved as an effective means of trapping the rhinoceros beetle. Ninety per cent control has been achieved by the method. The net which is long lasting can be recycled and the method is non-toxic and non-invasive. The fishnet has to be shifted to the inner leaf axils as and when new leaves emerge. It was an innovation by Dr. Nair through careful study of the feeding habit of beetle. Dr. Nair has employed a full time employee for placing the nets in frond axils, detect any rhinoceros beetles boring into the tissue, extracting them mechanically and keeping the crown very clean, for early detection of any attack of red palm weevil. Red palm weevil larvae were found to infest bole of the palm and crown. The weevil can lay eggs through small expansion cracks in the bole, through split wounds at the base of fronds, directly into fronds or on spindle leaves. The weevils get particularly attracted to rotten smell resulting from bud rot. Red palm weevils have turned out to be elusive and lethal. The weevil is the Achilles heel in coconut palm management. Early detection through systematic observations and chemical methods of control helped Dr. Nair to minimise loss of palms through the weevil attack.

Marketing

Another unique feature of coconut farming by Dr. Nair is that he sells coconut from his farm entirely as tender nuts to the nearby retail shops which fetch him Rs 35 per nut. Selling as tender coconut is always a better option because of the higher price compared to selling as mature nut, especially at a time when the coconut

price has slumped. Dr. Nair is an active member of the farmer collective of Karukachal which helps to market farm produce like banana through auctioning, thus ensuring a fair price.

Economics of coconut based mixed cropping

"Coconut farming can be made a remunerative enterprise provided, we make ourselves fully committed and involved in farming activities, adopt coconut based mixed cropping instead of coconut monocrop and above all manage the system scientifically" says Dr. Nair. If coconut is cultivated as a monocrop in a root (wilt) affected tract like Kottayam district under average management condition the average yield will be about 50 nuts per palm only, thus realising an annual net income of Rs. 1,70,000 per hectare. Meanwhile, if one hectare of coconut is managed scientifically as done by him the net income can be 10 times higher, if not more. Dr. Nair opines that amelioration of surface and subsoil acidity, adequate mineral nutrition of the palm (beyond NPK too), and subtle changes in agronomic management of the palm can go a long way in enhancing productivity and income from the palm. It is also worth mentioning that he provides year-round employment for two men and two-woman labourers in his farm. The rubber plantations, the most preferred in the region, on the other hand provides employment for only one man.

Innovations

Significant innovations were made by Dr. Nair in the way coconut palms are raised and managed. Thinking differently paid rich dividends to him.

- Planting of palms in larger and deeper pits filled with soil-dolomite mixture to ensure acid free soil medium in the rooting environment of the palm. The heavy dolomite input also ensures adequate long term availability to essential nutrients, calcium and magnesium.
- Dispensing with the annual ritual of opening and closing of basins around the palm coupled with zero tillage of interspaces. The practices permit palm roots to forage the fertile surface soils.
- Mulching with palm fronds to meet organic matter requirement of palm in place of external inputs of farmyard manure or compost.
- Relatively heavy input of magnesium sulfate to palm and all intercrops to alleviate subsoil acidity responsible for presence of toxic monomeric aluminium in subsoils of midland laterite soils.
- Regular input of micro-nutrients boron, zinc.
- Additional input of micro-nutrient chlorine (highly essential for coconut palm) through inputs of common salt.
- All fertilizers applied as soluble salts spread over the mulch around the palm (no mixing with soil).
- Input of fine granite rock powder, sourced from local rock crushers, @ 100 kg per coconut palm and @50 kg for all other perennials, for remineralisation of the highly weathered and leached laterite soils.
- Insertion of old, nylon fishnet pieces in frond axils as an effective, non-toxic, non-invasive means of controlling attack of rhinoceros beetle.

Surprise observations

- All palms in the farm had put out spadix in just three and half years after planting, irrespective of variety (TxD, NCD, WCT or Tiptur tall). The only exceptions were the few palms at the border to adjoining plot with rubber plantation.
- Five WCT palms putting out spadix by two and half years, during current year, was the stunner. It is not a chance incident, since the five are part of a lot of 50 WCT palms planted in 2021.

Way forward

Dr. Nair's vast experiences and expertise as a soil scientist, especially in leading the multi-institutional research project initiated by the Kerala State Planning Board in which experiments and demonstrations were conducted in farmer's fields across the state, convinced him that productivity of coconut can be nearly doubled by alleviation of soil related constraints to the palm; and again,he has demonstrated it in his own coconut garden. The experiences of Dr. K.M. Nair in scientifically managing the coconut based mixed cropping system as a highly remunerative enterprise is highly relevant in formulating and implementing interventions to regain the lost glory of coconut in the state.

Dr. Nair is very happy to share his experiences in managing coconut based mixed cropping systems with other farmers. Development and extension agencies implementing coconut related interventions can very well make use of the garden of Dr. Nair as a Farmer Field School on coconut based mixed cropping to provide experiential learning to farmers and extension personnel.

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Tree Fodder Banks in Coconut Garden for Quality Forage Production

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Livestock rearing is a major means of food and nutrition, and a source of subsidiary income for small and marginal farmers, landless labourers and household women in Kerala. Livestock like cattle, goats and buffaloes are integrated with farming systems or in homesteads and are mainly stall-fed with local fodder and forages through cut and carry systems. In recent decades the local fodder base in these regions have declined drastically due to intense demographic pressure, change in cropping pattern and other socio-economic reasons. The farmers' reliance on indigenous grasses, weeds, and agricultural left overs results in inadequate amounts and poor quality of nutrition especially during lean periods. Animals' dietary needs for crude protein are primarily satisfied by very costly commercial concentrate feeds, which significantly reduce farmer profits. Given that feed accounts for 60–70% of production costs, producing enough high-quality fodder on-farm is therefore highly recommended for profitable livestock housing. Farming systems should increase the output of fodder by supplementing conventional fodder with alternative, inexpensive protein sources, such as fodder trees.

Why fodder trees?

Fodder trees, with their nutrient rich leaves, constitute a potential source of quality green fodder to livestock especially during lean periods.When compared to fodder grass species, fodder trees have almost twice the amount of protein (18 to 25%) and high levels of essential elements like calcium, sodium, and sulphur as well as crucial micronutrients like iron and zinc,which can save farmers expenses on purchased concentrate feeds. Fodder trees have relatively deep roots which allow them to reach soil nutrients and moisture not available to grasses and herbaceous plants. This characteristic enables these plants to retain fresh foliage into the dry season. Trees require less management and care, and give consistent yield for a prolonged period.

Integration of trees in coconut plantations

Acute land scarcity in Kerala limits large scale fodder tree cultivation in open lands. Only alternative is to integrate trees with the existing cropping systems. Coconut is an important plantation crop in around 15 states in India covering an area of more than 20 lakh ha. On account of the wide inter spaces between coconut rows (7.6 m x 7.6 m) there is ample

Coconut garden spaced at 7.6 × 7.6 m Calliandra fodder banks underneath coconut

Mulberry and subabul fodder banks in coconut garden

scope for intercropping fodder trees especially during the early growth phase (up to 8 yrs) and later mature phase (>25 years) of the coconut plantation.

Relevance of tree fodder banks

In land crunch humid tropical regions like Kerala there is a need to utilize the available land and other resources in the most effective manner. Hedge row planting of fodder trees with higher tree densities as fodder banks is a possible option for enhancing productivity from limited land area. Moreover, while integrating with coconut, maintaining fodder trees as hedges also regulate the possible competition to the main crop and facilitate easy harvesting of fodder. Tree fodder banks can be maintained as "protein banks" for reducing the purchased concentrate feed, for year-round fodder production or to bridge fodder scarcity during annual dry seasons.

Suitable trees as fodder banks

The suitable fodder bank trees for Kerala include Subabul (*Leucaena leucocephala*), Calliandra (*Calliandracalothyrsus*), Gliricidia (*Gliricidia sepium*), Mulberry (*Morusindica*), Moringa (*Moringa oleifera*), Erythrina (*Erythrina indica*) and Agathi (*Sesbania grandiflora*), by virtue of their nutritive foliage, fast growing nature, ability to withstand heavy pruning, good coppicing ability and higher biomass production. They can be grown in close hedge rows and can be harvested frequently to yield quality forage. The invasive nature of popular fodder tree species like subabul due to prolific seed production can also be prevented by maintaing the trees in the vegetative stage by recurrent pruning.

Harvested calliandra fodder

Cultivation of tree fodder banks under coconut garden

Raising planting stock

The first step is to raise quality planting materials of tree species in nursery. Calliandra, moringa and agathi are to be raised from seeds; and gliricidia and mulberry from cuttings. Seeds of calliandra and agathi should be presoaked in water for 48 and 12 hours respectively before sowing for ensuring good germination. Subabul seeds should be treated with concentrated sulfuric acids for 4 minutes and then washed with hot water for successful germination. Seeds should be sown in nursery in beds of standard size. Healthy and uniform seedlings will be transplanted to polythene bags filled with potting mixture (soil: coir pith: FYM in 2:1:1 ratio) after one month and later transplanted to the field on attaining 20-30 cm height. For mulberry, six to eight months old cuttings of pencil thickness having 20 cm length and with 4 to 5 active buds should be planted in polybags and later transplanted at 3 months stage. Gliricidia can be easily established using thick stem cutting of not less than 3cm diameter and 40 cm length directly in the field.

Field planting

The field area in the interspaces of coconut (excluding coconut basin of 2m radius) should be ploughed twice and levelled. All weeds and stubbles

cattle feeding tree fodder

should be removed from the area. Seedlings should be planted as hedge rows with inter and intra row spacing of 45 to 60 cm. Pits should be taken at required spacing and 1 kg FYM should be added in each pit and mixed well. Seedlings should be planted with the onset of monsoon. During initial period of growth (first six months), proper weeding and climber cutting should be done at least once in a month.

Tree nutrition

For leguminous fodder trees such as subabul, gliricidia and calliandra, the recommended fertilizer dose is 90:300:70 Kg ha-1 (Urea, Mussoriephos, Muriate of potash) in split doses (3 weeks after planting and after harvest). For those fodder trees that lack the ability to fix atmospheric nitrogen (mulberry), the recommended fertilizer dose is 600:600:200 kg ha-1 (Urea, mussoriephos, muriate of potash) in 5 split doses. To avoid competition, coconut should also be supplied with adequate nutrition.

Tree management

Numerous studies on fodder trees indicated that management factors such as cutting height and cutting interval not only affected fodder yield per unit area but also long-term productivity and quality of the forage, which should be considered while establishing fodder banks. After planting, first harvest can usually be done after 6 months. However, taking first harvest after 9 – 12 months gives more healthy and sturdy trees with strong well developed root

Goats feeding tree fodder

system. The branches can be harvested at a height of 1 m from the ground level. Subsequent harvesting can be taken at an interval of two months during rainy season and 3 to 4 months during dry season. Since the new shoots developed during this short harvest interval are nutrient rich, with more foliage and succulent stem, the entire harvested biomass can be fed to the cattle without any wastage.

Forage yield and feeding

An average annual forage yield of 20 to 25 tonnes can be expected from one hectare coconut garden during the initial year of establishment. Subsequently higher yields of 40 to 50 tonnes can be expected with proper management for a period of 8 to 10 years. About 5 to 7 kg of tree leaves can be fed to cattle daily. However due to mimosine content, subabul should be fed only up to 4 kg/day. About 500 to 600 fodder trees will be needed to feed a dairy cattle @ 2 kg dry matter/day.

Introducing intensively managed tree fodder banks in the unutilized interspaces of coconut plantations can be a prudent approach for generating highly nutritious fodder for economic feeding of livestock. Fodder tree integration can also provide additional income to coconut growers and enhance overall profitability of the system.

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Soil Health Management In Coconut

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Coconut is cultivated globally and a major source of livelihood security to billions of people. We face challenges like increasing cost of cultivation, reduced soil fertility, lack of availability of inputs, price fluctuation of output etc. Of this deteriorating soil health is of paramount importance since everything depends and start from soil. Coconut is mainly cultivated in laterite, red soil and sandy soil which are naturally low in soil fertility. Since the crop is perennial and continues its growth throughout the year, nutrient removal is very high. Proper manuring is very important since imbalanced application leads to nutrient deficiency or toxicity in both highly fertile and poorly fertile soil. Before cultivation, one should understand about the nutrient status of the soil, nutrient removal, nutrient requirement of soil and moisture conservation practises. Productivity can be enhanced by using proper soil management practices.

Coconut grows well in well drained aerated and near neutral soil (pH 5-8) with good water holding capacity. About 45 % of the roots are present within 2 m radius and 1.2 m depth. For better anchorage and support, plant coconut to a minimum depth of 1 m. It can tolerate soil salinity since it is a semi halophytic plant. It can be grown in less fertile soil with appropriate management practices provided that there is good soil drainage and aeration since it responds well to judicious fertilizer application and irrigation. Coconut can withstand very high rainfall in well drained soils. Very low temperature results in fruit abnormalities.

Red and laterite soils are loose, porous, well drained with poor water retention power and highly leached acidic pH, excess aluminium, iron, manganese, low ion exchange capacity and poor nutrient retention power. Sandy soil is low in organic matter content and have low water and nutrient retention power. Leaching losses of applied nutrients is very high in heavy rainfall area.

For the successful management of coconut in these type of soil we have to improve the soil organic matter content and use soil moisture conservation methods. Fodder grass is grown as intercrop in coconut garden along with soil moisture conservation methods.

Burial of one layer of dried coconut husk in trenches and applying five cm of coir pith helps to increase availability of nutrients and rhizosphere activities. Intercropping with *glyricidia sepium*

improves physical characteristics of soil. It reduces soil compaction also.

Red and laterite soils are lateral soil that acidic and is deficient in essential plant nutrients like K and Mg. The high content of aluminium and iron convert soluble phosphate into insoluble phosphate. The acidity can be reduced by adding liming material based on the lime requirement. Nowadays application of seaweed as manure reduces acidity. Salinity problem is observed in low lying areas which is one of the the constraints for coconut cultivation to a certain extend. Drainage and check bunds can reduce the problems due to flooding of saline water and sulphur /gypsum is mainly applied in such types of saline soil. We can also apply more organic matter in planting pits along with equal proportion of soil – sand mixture. This will reduce the salinity problems. Nitrogen, Boron, Calcium deficiency is seen in India.

Nitrogen, potassium, phosphorus requirement is 2 :1: 3 for coconut. In the case of nutrient removal by the palm, potassium is removed followed by nitrogen, calcium, magnesium, phosphorus. Cultural practices like intercropping (twice a year) and weed control alone cannot sustain high productivity of the soil. Supplement the palm with inorganic fertilizers and organic manures.

Slow release of nitrogen fertilizers like urea form, neem cake coated urea, and coir dust mixed with urea sustain for longer periods in soil, improving the nitrogen availability. We can save 25 % of the recommended fertilizer by adopting feritigation methods like drip irrigation rather than NPK application in the soil. K & Cl are important for maintaining water status of the coconut seedlings by improved stomatal regulation, water uptake and osmotic adjustment of tissues under water stress. Magnesium and Sulphur are very important micronutrients for the productivity. Soils with low organic matter without sufficient sulphur fertilization suffer from sulphur deficiency. Sulphur management can be achieved by using super phosphate, ammonium sulfphate, diammonium phosphate, Magnesium sulphate etc.

Boron deficiency causes crown chocking and reduction in coconut productivity. It can be cured by application of 300 gram and 500 gram borax per palm per year in two split doses for seedlings and adult palm respectively. Copper and zinc deficiency is

observed in coconut rapid decline (CRD) disorder affected palms. With common salt treatment or micro nutrient treatment this disorder can be reduced and the number of fronds water status are improved.

Around seven tonnes of coconut wastes (leaf, bunch waste, husk) are available from one hectare of well managed coconut garden.This waste can be recycled along with the intercop waste and animal wastes. Natural decomposition of coconut waste is slow, It can be enhanced by using Eudrillus species of earthworms (vermi composting). 4 tonnes of vermi compost can be produced from waste generated from one hectare of healthy coconut plantation annually. Coconut leaf vermiwash contain nutrients, sugar, amino acid, phenols etc. Some crops like mimosa species, cowpea etc can be grown as cover crop in 1.8 m radius basin area which contribute organic matter and nutrients to the coconut.

Nut yield can be increased by the application of coirpith along with the recommended chemical fertilizers. Application of fully decomposed coir pith per palm per year is also followed. Soil nitrogen is enhanced on application of glyricidia which can be substituted with 50% of nitrogen. Since cost of cultivation by using organic manure is very high we have to search for alternative to reduce the cost of cultivation along with improving the productivity. Coconut based cropping system using intercrop as the best alternative when intercrops are introduced there is reduced evapotranspiration due to the change in micro climate of the area reducing the water requirement of coconut.

Fodder grass (hybrid Napier, guinea grass) are more productive under coconut. On root wilt disease affected palms of West coast tall variety application of 50 % fertilizers along with organic manures increases

17% yield. Yield can also be increased by basin raising of elephant foot yam, pineapple, banana, black pepper etc, recycling of organic biomass and incorporation of green manure crop.

Coconut based integrated farming system

Animal biomass in cow dung, poultry manure, urine, cowshed wastes contribute NPK through recycling so that chemical fertilizer requirement is drasticly reduced. It improves soil physical properties

Addition of organic manures like vermi compost, coirpith with compost, farmyard manure, neem cake and green manures favour the growth of beneficial microorganisms. This can be applied along with biofertilizer (100 g per palm) in the coconut basin twice in a year by mixing the top soil followed by application of organic amendments (vermicompost-20 kilogram). Even in the root wilt affected area interopping with fodder hybrid and enhances soil microbes.

Since coconut is an important crop that sustain livelihood of poor farmers, productivity should be improved after ameliorating soil constraints.Site specific soil management strategy can improve the coconut yield in an ecofriendly way.

CDB pavillion bagged 2nd prize for Excellence in Display in India International Trade Fair, 2023

CDB MDIC, New Delhi, participated in the 42nd India international Trade Fair 2023 held at Pragati Maiden New Delhi from 14th to 27th November 2023. Coconut Development Board bagged the 2nd Prize among the Commodity Boards pavilion for "Excellence in display". Shri. Jayakumar. S Market Development Officer received the Memento and Certificate from Shri. Pradeep Singh Kharola, Chairman and Managing Director, India Trade Promotion Organization (ITPO). Board displayed various informative posters on Board's schemes and on the goodness of coconut, along with publications of the Board. Manufacturers of various value added products viz virgin coconut oil, tender coconut halva, neera in tetra pack, coconut mud soap coconut oil, tender coconut water etc participated in the fair under CDB's banner.

Krishi Mela -2023

Coconut Development Board, Regional Office, Bangalore participated in the Krishi Mela -2023 held from 17th to 20th November, 2023 at University of Agricultural Sciences, Bangalore. The Krishimela -2023 was inaugurated by Shri. Siddaramaiah, Hon'ble Chief Minister of Karnataka. Shri. D. K. Shivakumar, Hon'ble Deputy Chief Minister, Shri. N. Chaluvaraya Swamy, Hon'ble Minister of Agriculture, Government of Karnataka and other dignitaries including Dr. S.V. Suresha, Vice Chancellor, UAS, Bangalore were present during the occasion.

Krishi Mela 2023 attracted more than 10 lakh visitors to explore nearly 625 stalls put up by various government departments, NGOs and private firms besides FPOs and co-operatives. CDB stall was visited by many and enquiries were received on scientific cultivation of coconut, coconut processing technologies and availability of quality seedlings. Board displayed various value added coconut products like Neera, Coconut milk, Coconut milk powder, Virgin Coconut Oil, Coconut chips and many other products along with handicrafts made from coconut shell, coir and wood. The stall was affixed with well informative posters displaying CDB schemes viz., AEP, Kera Suraksha, Coconut Nursery, FoCT, TMoC, CDB-Market promotion, CIT training programmes etc. Booklets on CDB Schemes, Coconut products, Cultivation Technologies, Neera and journals in Kannada, English and Hindi were distributed in CDB stall. M/s. Gurushri Farmer Producer Company Limited, Tumkur displayed and sold Neera through kiosk in the stall.

Cultivation Practices for Coconut - January

Collection and storage of seed nuts

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

Nursery management

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

Shading

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

Irrigation

Irrigation has to be continued in coconut gardens. If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm. Drip irrigation is the ideal method of irrigation for coconut. The number of dripping points should be six for sandy soils and four for other soil types. Depending on the evaporation rate, quantity of water to be provided through drip irrigation system in different coconut growing tracts can be decided. In Kerala 30-35 litres and in Tamil Nadu and Karnataka 35-45 litres of water is sufficient per palm per day through drip irrigation system during January.

Removal of senile and unproductive coconut palms

Cut and remove senile and unproductive palms in the coconut garden and dispose them properly to maintain the field hygiene.

Management of pests and diseases

January month is the critical winter month with cool night and hot day. The humidity comes down and the Tamil calendar celebrates Pongal, with farmer's festival. Bountiful harvests in all crops are accomplished. Pest vigilance in this period should be strengthened as this period opens out dry day time with cool night favouring population build up of sucking pests and dry pathogens. Breeding pits of coconut rhinoceros beetle get dried favouring egg laying and development of grubs. The establishment

Pest-infested field

Black headed caterpillar

Goniozus nephantidis

of moth pests, viz., black headed caterpillar and slug caterpillar is aptly virulent and successful in this month in all endemic zones of Kerala, Tamil Nadu, Andhra Pradesh and Karnataka.

▶ *Black headed caterpillar, Opisina arenosella*

The coconut black headed caterpillar, Opisina arenosella, is a major pest distributed in almost all coconut growing tracts across the country especially along the water bodies during winter.The infested portions get dried and form conspicuous grey patches on the upper surface of the lower fronds. Severe pest damage results in complete drying of middle to inner whorl of fronds leaving a burnt appearance. Presence of black headed caterpillars, webbing of leaflets and occurrence of dried faecal matter on the leaflets are the characteristic features of pest incidence. In the absence of natural enemies in the new area of emergence, the outbreak becomes faster and expands at high speed. Damage results in tremendous reduction in photosynthetic area, decline in rate of production of spikes, increased premature nut fall and retarded growth. Extensive feeding of caterpillars causes a crop loss of 45.4% in terms of nut yield in addition to rendering the fronds unsuitable for thatching and other purposes. Farmers need not panic and this is one of the classical examples of successful augmentative biological control suppressed by natural enemies.

Management

a) Regular monitoring of palm fronds for pest occurrence in endemic zones.

b) Removal and destruction of 2-3 older and dried leaves harbouring various stages of the pest. The leaflets could be burnt to reduce the caterpillar/ pupal population.

c) Domestic quarantine should be strengthened by not transporting coconut fronds from pest-infested zone to pest free zone.

d) Augmentative release of the larval parasitoids viz., Goniozus nephantidis (20 parasitoids per palm) and Bracon brevicornis(30 parasitoids per palm) if the pest stages is at third-instar larvae and above. The pre-pupal parasitoid (*Elasmus nephantidis*) and pupal parasitoid (*Brachymeria nosatoi*) are equally effective in pest suppression and are released at the rates of 49% and 32%, respectively for every 100 pre-pupae and pupae estimated.

e) Before releasing, the parasitoids need to be adequately fed with honey and exposed to host odours (gallery volatiles) for enhancing host searching ability.

f) Ensure adequate irrigation and recommended application of nutrients for improvement of palm health.

▶ *Nut borer, Cyclodes omma*

Incidence of nut boroer was observed in certain coconut gardens in Pollachi (Tamil Nadu). This is a sporadic pest normally found in dwarf genotypes and also in hybrids. Succulency due to excessive nutrition by nitrogenous fertilizers is also one of the factors responsible for pest outbreak. Caterpillars bore into buttons after pollination as well as immature nuts and feed on the internal contents during night hours, resulting in button shedding. Palms subjected to assisted pollination are more susceptible to pest attack. The pupal stages are observed on the debris of palm crown.

1. Nut boring caterpillar

2. Damaged buttons

3. Adult noctuid moth


Mite damaged nuts


Progression of mite damage


Mite colony

Management

a) Crown cleaning and removal of immature stages of the pest

b) Judicious and need based application of nitrogenous fertilizers to avoid succulency

c) Application of the entomopathogen, Bacillus thuringiensis @ 20 g per litre or neem oil 0.5% (5 ml per litre with 10 g soap powder) using hand sprayers would reduce pest incidence.

▶ *Coconut eriophyid mite, Aceria guerreronis*

Coconut eriophyid mite is the invasive pest reported from our country during 1998 and has been on the rise during post-winter season. It belongs to the spider family with two pairs of legs, sub-microscopic (200-250 microns size), lays about 100-150 eggs and the life cycle complete in 7-10 days. Mites infests the developng nuts immediately after pollination and are confined within the floral bracts (tepals) and feeds on the meristematic tissues beneath the perianth. Appearance of elongated white streak below the perianth is the first visible symptom. Within few days, yellow halo appears round the perianth, which turns as warts and finally develops as cracks, cuts and gummosis. Shedding of buttons, immature nuts and malformation of nuts are other indications of mite damage.

Management

a) Removal and destruction of dried spathes, inflorescence parts and fallen nuts to subdue the pest population

b) Spraying 2% neem-garlic emulsion or azadirachtin 10000 ppm @0.004% or root feeding with neem formulation containing azadirachtin 10000 ppm at 10 ml with equal volume of water three times during March-April, October-November and December – January is recommended. Prophylactic application before the increase in summer temperature should be resorted to.

c) Application of talc-based preparation of acaropathogen, Hirsutella thompsonii@ 20 g / litre/ palm containing 1.6 x 108cfu three times in synergy with neem formulation.

d) Kalpaharitha (a selection from Kulasekharam Tall) was found field tolerant to mite damage.

e) Application of recommended dose of fertilizers, recycling of biomass, raising of green manure crops in palm basin and incorporation during flowering, summer irrigation including soil and water conservation measures improve the palm health and reduce the pest attack.

Disease

▶ *Leaf blight of coconut (Lasiodiplodia theobromae)*

Leaf blight is an emerging disease in Coimbatore, Erode, Dindigul, Tirunelveli and Kanyakumari districts of Tamil Nadu. The pathogen causes damage in leaf and nuts. Affected leaflets start drying from the tip downwards and exhibit a charred or burnt appearance. The leaves in lower 3 to 4 whorls are affected. Leaf blight causes apical necrosis of lower leaves with an inverted “V” shape, and symptoms similar to those induced by drought (water deficit) and other stresses. The leaflets have extensive necrotic lesions with defined edges and without transition areas between the necrotic and healthy tissues. The pathogen can internally colonize the rachis, inducing internal necrosis that moves upward towards the stem (systemic invasion).

The necrotic tissues develop exposed cracks that release gums under the leaf rachis and at petiole insertion. On coconuts, small black sunken region appear near the perianth of immature nuts. When nearly mature /mature nuts were infected, the infection spread internally into mesocarp without any external symptoms. The affected nuts are desiccated, shrunk, deformed and drop prematurely causing 10% to 25 % loss in nut yield.

Management

a) Improving the palm health by application of 5 kg of neem cake enriched with Trichoderma harzianum and soil test based nutrition.

b) Adequate irrigation and adoption of soil and water conservation measures is advised.

c) Root feeding of hexaconazole @ 2% (100 ml solution per palm) thrice a year.

Root (wilt) disease

Root (wilt) disease (RWD) is prevalent in a contiguous manner in all the eight southern districts of Kerala starting from Thiruvananthapuram to Thrissur and in isolated patches in the remaining six northern districts of the state. The disease is also prevalent in Coimbatore, Theni, Senkottai and Kanyakumari districts of Tamil Nadu. The presence of the disease has been recorded from Dakshina Kannada district of Karnataka and Goa as well.

The most obvious and diagnostic symptom of the disease is the abnormal inward bending of the leaflets termed ribbing or flaccidity. Yellowing and marginal necrosis of leaflets are the other characteristic foliar symptoms associated with the disease. Rotting of roots, shedding of immature nuts, drying up of spathes and necrosis of spikelets in unopened inflorescence is noticed in certain cases. The husk, kernel and oil of the nuts of the disease affected palms are of poor quality. Palms of all age groups are affected. The disease is non lethal, but debilitating. However, palms contracting the disease in the pre bearing age may not come to flowering and bearing. The disease also causes several internal changes in the palm.

A phloem bound mollicute – phytoplasma belonging to 16SrRNA group XI has been identified as the pathogen. The insect vectors transmitting the disease have been identified as lace bug (Stephanitis typica) and plant hopper (Proutista moesta). The coconut RWD has been found to occur on all soil types of Kerala under varying ecological conditions ranging from the high ranges of the Western Ghats to the coastal plains.

Management

One of the significant features of the disease is that it is not lethal but a debilitating malady which responds to ideal management practices. Two strategies, one for the heavily diseased contiguous area, and another for the mildly affected area have been formulated.

a. Strategy for heavily diseased tracts

In the heavily diseased area, the yield of palms can be sustained or even improved through adoption of integrated management practices:

- Removal of disease advanced and juvenile palms.
- Management of leaf rot disease.
- Balanced fertilizer application.
- Addition of organic manures.
- Raising of green manure crops in the basins and incorporation.
- Irrigation during summer months.
- Management of pests.
- Adopting inter and mixed cropping.
- Mixed farming in the diseased gardens involving raising of fodder crops in the inter spaces, maintaining milch cows and recycling of organic waste.

b. Strategy for mildly affected area

Removing all the diseased palms: The spread of the disease can be arrested by systematic surveillance and rouging of diseased palms as and when identified. Accurate and timely diagnosis of plant diseases is an essential component of integrated disease control. ELISA test has been developed at CPCRI for the early diagnosis of this disease. The disease affected palms can be detected even 24 months before the expression of symptoms and they can be removed to avoid further spread.

Replanting with disease free healthy seedlings: Replanting with quality seedlings has to be undertaken only in gardens with sufficient space. As RWD is not amenable to conventional plant protection measures, cultivation of resistant varieties

is the most ideal method for management. The resistant/tolerant varieties Kalparaksha (selection from Malayan Green Dwarf), Kalpasree (selection from Chowghat Green Dwarf) and the hybrid Kalpasankara (Chowghat Green Dwarf X West Coast Tall) released from Central Plantation Crops Research Institute (CPCRI) are suitable for cultivation in RWD endemic tracts.

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

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

Market Review – November 2023

Domestic Price

Coconut Oil

During the month of November 2023, the price of coconut oil opened at Rs. 14000 per quintal at Kochi market, Rs.14300 per quintal at Alappuzha market and Rs.15650 per quintal at Kozhikode market.

The price of coconut oil closed at Rs.14000 per quintal at Kochi, Rs.14200 per quintal at Alappuzha market and Rs.15650 per quintal at Kozhikode market with a net loss of Rs. 100 per quintal at Alappuzha market and the price of coconut oil at Kochi and Kozhikode market opened and closed at the same price during the month.

During the month, the price of coconut oil at Kangayam market opened at Rs. 12200 per quintal and closed at Rs. 11533 per quintal with a net loss of Rs. 667 per quintal

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.11.2023	14000	14300	15650	12200
04.11.2023	14000	14200	15650	12000
11.11.2023	13900	14100	15650	11867
18.11.2023	14000	14200	15650	11867
25.11.2023	14000	14200	15650	11667
30.11.2023	14000	14200	15650	11533

Milling copra

During the month, the price of milling copra opened at Rs.9400 per quintal at Kochi, Rs.9450 per quintal at Alappuzha and Rs.9750 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 9300 per quintal at Kochi market, Rs. 9350 per quintal at Alappuzha market and Rs. 9650 per quintal at Kozhikode market with a net loss of Rs.100 per quintal at Kochi, Alappuzha and Kozhikode market and it showed a downward trend during the month.

During the month, the price of milling copra at Kangayam market opened at Rs.8700 and closed at Rs.8500 with a net loss of Rs.200 per quintal during the month.

**NR-Not reported*

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.11.2023	9400	9450	9750	8700
04.11.2023	9400	9350	9750	8700
11.11.2023	9300	9250	9700	8600
18.11.2023	9300	9350	9700	8600
25.11.2023	9300	9350	9650	8600
30.11.2023	9300	9350	9650	8500

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 10200 per quintal expressed a downward trend during the month and closed at Rs. 9600 per quintal with a net loss of Rs. 600 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.11.2023	10200
04.11.2023	9800
11.11.2023	9500
18.11.2023	9500
25.11.2023	9500
30.11.2023	9600

Ball copra

The price of ball copra at Tiptur market opened at Rs. 8500 per quintal and closed at Rs.7500 per quintal with a net loss of Rs. 1000 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
01.11.2023	8500
04.11.2023	8200
11.11.2023	8226
18.11.2023	8000
25.11.2023	8000
30.11.2023	7500

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs. 11000 per quintal and closed at the same price during the month.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.11.2023	11000
04.11.2023	11000
11.11.2023	11000
18.11.2023	11000
25.11.2023	11000
30.11.2023	11000

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs. 13000 per thousand nuts and closed at the same price during the month.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 28500 per ton and closed at Rs. 29500 per ton with a net gain of Rs.1000 during the month.

At Bangalore market in Karnataka, the price of coconut opened at Rs. 20000 per thousand nuts and the price was almost steady during the month.

At Mangalore market in Karnataka, the price of coconut opened Rs. 32000 per ton and the price was almost steady during the month.

Weekly price of coconut at major markets				
	Nedu-mangad (Rs./1000 coconuts)#	Pollachi (Rs./ MT) ##	Bangalore Grade-1 coco-nut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 tonne) ##
01.11.2023	13000	28500	20000	32000
04.11.2023	13000	29000	20000	32000
11.11.2023	13000	29500	20000	32000
18.11.2023	13000	30750	20000	32000
25.11.2023	13000	30500	20000	30000
30.11.2023	13000	29500	20000	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*
04.11.2023	123	171	226	348
11.11.2023	125	185	226	354
18.11.2023	125	187	NR	369
25.11.2023	129	186	NR	366
				*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)	Philip-pines	Indo-nesia	Sri lanka	India*
04.11.2023	1093	1101	NR	1733	1440
11.11.2023	1105	1102	NR	1751	1424
18.11.2023	1135	1120	NR	NR	1424
25.11.2023	1138	1132	NR	NR	1400
					*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
04.11.2023	604	602	942	1044
11.11.2023	621	608	1020	1032
18.11.2023	624	622	NR	1032
25.11.2023	624	627	NR	1032
				* Kangayam

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

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