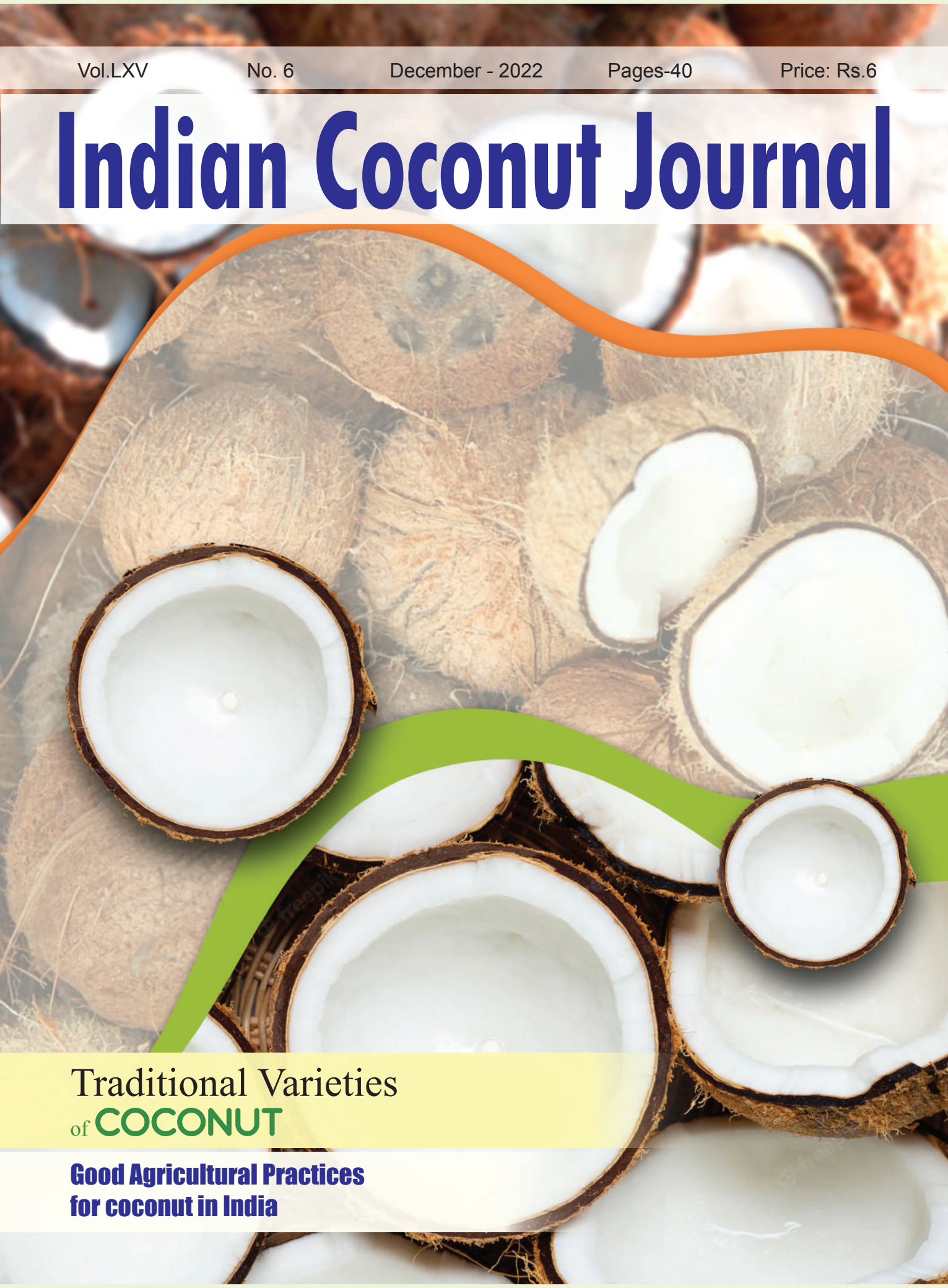
Vol.LXV No. 6 December - 2022 Pages-40 Price: Rs.6

Indian Coconut Journal



Traditional Varieties of COCONUT

Good Agricultural Practices for coconut in India

INDIAN
COCONUT
JOURNAL

Vol. LXV No.6
December - 2022
Kochi - 11

Publisher
COCONUT DEVELOPMENT BOARD
Ministry of Agriculture and Farmer's Welfare,
Department of Agriculture, Government of India
Kera Bhavan, Kochi - 682 011, India

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SUBSCRIPTION

Annual	Rs. 60.00
Single Copy	Rs. 6.00
Institutes / Libraries	
Annual	Rs. 200.00
Single Copy	Rs. 20.00

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

Coconut Development Board

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

Functions

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

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

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

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Message

Dear Readers,

We are at the fag end of the year 2022 and a new year 2023 is about to start, offering new beginnings and fresh hopes. With the COP 27 meet urging for collective action towards the agreed climate goals, it is important to plan activities against the backdrop of increasing extreme weather events in this period of New Year Eve.

Coconut is an ideal crop where activities in cultivation starting from pre and post production, post harvest management, processing and marketing should imbibe options that will make the process viable in economic and environmental terms. Promoting organic cultivation is one way of achieving natural resource management since it enriches the carbon sink, recycles organic matter and produces quality products for the consumers. On the processing side, integrated processing aiming at zero waste will not only result in greater resource efficiency but also will generate innovative products with consumer demand. Energy savings through improved production systems, reduction in water consumption, improved work conditions for the employees etc also impact the economic and environmental viability. In the case of coconut, the specialty features of natural products which are nutritious and healthy, non-food products which are biodegradable, products with substitution option for those that degrade the environment etc offer much prospects in future while moving towards climate resilience.

Coconut farmers had struggled during 2022 with low prices and the procurement at Minimum Support Price in major coconut growing countries could offer only a streak of light in the distress situation. Creation of infrastructure for copra making will not only equip the small and marginal coconut farmers in realizing the benefits offered by Government of India through procurement at Minimum Support Price but will also help in farmers venturing into primary processing. This will pave the way for farmer owned ventures in processing and value addition of coconut. Adopting zero waste policy will lead to revenue from by-products like husk, shell and coconut water supporting the main enterprise through prospects of price flexibility, added returns, diverse products with varied applications etc leading to a healthy and viable coconut sector.

The world is going to be increasingly conscious of environmental conservation, farmer remuneration, natural resource management, economic viability, biodegradability etc in the coming days which will definitely impact the consumer purchase decisions. With a crop like coconut which is very much suited to climate resilient agriculture, let us work together to reap the benefits for the welfare of the coconut community.

Editor

Traditional Varieties of COCONUT

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

Plant Habit

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

(1) Tall palms:

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

(2) Dwarf palms:

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

Most popular indigenous dwarf cultivars are Chowghat Green Dwarf, Chowghat Orange Dwarf and Gangabondam.

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

West Coast Tall

West Coast Tall is a popular tall cultivar grown along the west coast of India. It is a high yielder under good management conditions. WCT has been extensively cultivated as it can grow in varied agroclimatic conditions and soil types. The inflorescences have distinct male and female phases. The palm is cross pollinated. The fruits vary in colour from green to greenish yellow to different shades of brown. The shape of the fruit varies from oval to oblong. This cultivar commences to yield in about 6 to 8 years after planting under favourable conditions. This variety is useful for household purposes such as production of copra, coconut oil, coir etc. The palm yields good quality and quantity of coconut sap or toddy which can be made into jaggery or sugar. It produces good quality husk which is extensively used in making coir and coir products. It is tolerant to drought. Annual average yield is 60 to 80 nuts per palm. Copra content is 165 g/ nut. The variety is excellent for tapping and tender coconut production. The WCT variety shows greater resistance to pests and diseases.

KAPPADAM

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

KOMADAN

Seen most predominantly in Central Kerala and Northern Kerala, Komadan is having a egular bearing habit, tall variety produce green coloured nuts. Komadan had greater nut production potential than WCT. Average annual yield is 120 nuts per palm. Copra content per nut is 150 -180 g. This variety is good for cooking purposes, making copra and also for coir production. This variety is highly suitable for tender coconut water and also for making toddy. It yields more than 300 ml volume of tender nut water.

SPICATA

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

LAKSHADWEEP ORDINARY

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

CHOWGHAT ORANGE DWARF

Extensively grown in Chowghat regions of Thrissur district, this variety is commonly known as " Gowrigathram or Chenthengu". This is an early flowering cultivar and takes about 3 to 4 years after planting for initial flowering. The palms have characteristic orange colour on leaf petioles, inflorescences and fruits. Overlapping of male and female phase is noticed in this type. The palms shows both self and cross pollination and hence it is noted that 80 percent of the progenies breed true to type, and the remaining 20 percent progenies as off types. The nuts are spherical and medium sized. Average annual yield is 80-100 nuts per palm¬ and copra content is 99 g. This has large number of female flowers in the inflorescence.It produces good quality tender coconut water and the quantity of tender nut water is 400 ml.

CHOWGHAT GREEN DWARF

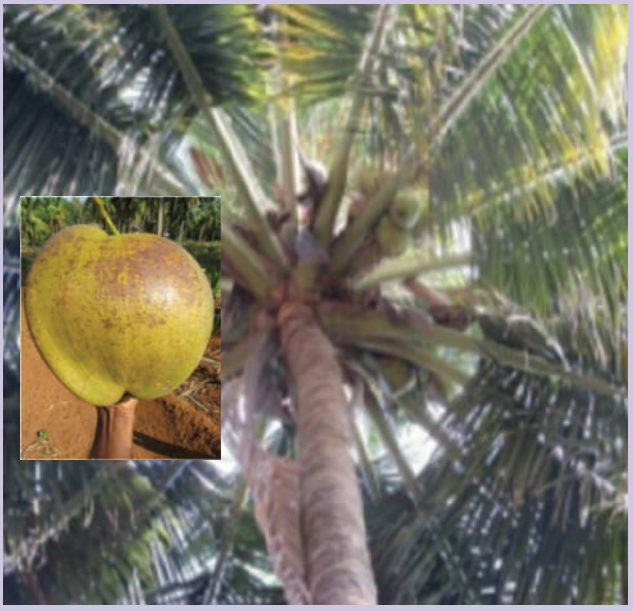
It is one of the famous dwarf varieties of coconut in India, extensively grown in Chowghat regions of Thrissur district. This variety is commonly known as "Pathinettam Patta". It takes only 3-4 years to produce fruits. This is characterized by dark green colored nuts and leaves. These produce oblong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

ANDAMAN ORDINARY

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

SANRAMON

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



GANGABONDAM

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

Conclusion

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

Coconut Flour as a Functional Food

The Future Perspectives

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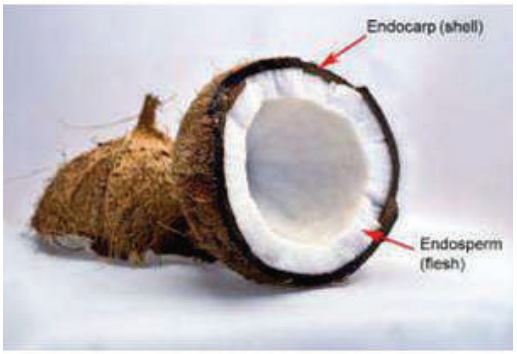
In tropical regions, coconut is a tree of great significance: that provides millions of people with food, employment, and business opportunities. The fruit is called 'miracle fruit'. Coconut flour is made by milling dried/desiccated coconut endosperm (copra). Coconut flour is a functional ingredient with high nutritional content and is naturally gluten-free, giving it many uses in bakery products. The term functional ingredient is meant to convey the function of ingredients, which is to produce a positive health outcome via physiological activity in the body. Compared to wheat flour, coconut flour has more fat, protein, and fiber. Iron is the primary mineral present in coconut flour. Coconut flour is used as a substitute for wheat flour. It can be incorporated into various food products, such as bakery, extruded products, snacks, and sweets. The functionality of coconut flour in terms of prevention for chronic diseases, e.g., diabetes mellitus, cardiovascular diseases, and colon cancer, leads to increased coconut and coconut flour production. The increase in health consciousness by the population following post-pandemic COVID-19 can lead to increased consumption of healthy foods, including coconut flour. Consumer demand for functional foods and organic products is growing nowadays. Increasing demand for safe, efficacious, and quality natural therapeutic products considering mushrooming world population and high cost of drugs can lead to increased consumption of coconut flour—growing awareness of the value of food and nutrition in preventing diseases. Different recipes from coconut flour are needed for increased consumption and improved health by populations.

Introduction

Coconut flour is one of the many food products made from the fruit of the palm tree *Cocos nucifera.* In tropical regions, coconut is a tree of great significance: that provides millions of people with food, employment, and business opportunities (Karandeep et al., 2019). The fruit is called 'miracle fruit' due to its inherent rich profile of macro-and

micro-nutrients for human nutrition and health (Karandeep et al., 2019). Coconut flour is made by milling dried/desiccated coconut endosperm (copra). Thus, it is from dried, ground coconut meat.

Production of this flour is very economical. Coconut flour has high nutritional content and is naturally gluten-free, giving it many uses in bakery products such as bread or cookies (Trinidad et al.,2006).



Functional food is any food that imparts a positive effect on people's health and provides essential nutrition. Functional ingredients are a diverse group of compounds intended to affect the consumer's health positively. The term functional ingredient is meant to convey the function of these new ingredients, which is to produce a positive health outcome via physiological activity in the body (*Trinidad et al., 2006*). Compared to wheat flour, coconut flour has more fat, protein, and fiber. Iron is the primary mineral present in coconut flour, making it a good option for people on vegan or vegetarian diets who are concerned about getting enough iron (*Trinidad et al., 2006*). Nevertheless, coconut meal has nutraceutical properties, making it useful for human consumption, and should be incorporated in various food products. Coconut flour is also gluten-free, and its nutritional composition is quite comparable to that of wheat flour. Gluten-free food products enriched with coconut flour are a healthy and viable option for people with celiac disease (Karandeep et al., 2019). Coconut palm can be processed into coconut water, coconut milk, coconut sugar, coconut oil, and coconut meat. Coconut consists of an outer fibrous coat or husk known as exocarp, and inner hard protective endocarp, or shell. A white albuminous part is an endosperm or coconut meat, and the inner cavity is filled with a clear fluid called coconut water (Karandeep et al., 2019).

Processing of coconut flour

The manufacturing of coconut flour involves two processing methods: dry and wet ones, and this also depends on the technology used and the type of industry.

The dry process involves drying grates from fresh mature coconut meat and virgin coconut oil extraction/pressing. The white low-fat residue/ meat obtained is ground to make coconut flour. The process produces a high protein coconut flour (33%) which can be used as a wheat substitute. The advantages of this process is the high oil recovery at 88% based on the oil content of the meat (65%) or 58% of the dried granulated meat and good quality of the oil with a free fatty acid content of 0.1% (Karandeep et al., 2019). The oil is removed by pressing and/or solvent extraction, and the remaining coconut meal is milled into a fine flour(Srivastava, et al., 2011).

On the other hand, Virgin coconut meal is obtained after removing virgin coconut oil from fresh coconut meat. It is high in insoluble dietary fiber and protein. Coconut flour is a by-product of coconut milk and the oil industry made from coconut meal leftover after processing (Karandeep et al., 2019). The coconut flour contains carbohydrates, protein and dietary fiber, which can also be used for food enrichment (Srivastava, et al., 2011).

In wet process the meat is extracted with milk, the residue and grinded to produce the flour. In the wet process, almost 52% of the available oil in the fresh meat is recovered. The meal or residue that remains still contains a lot of oil - 35-48% fat content in which 38% colorless oil is recovered and 40% coconut flour is obtained as a by-product. In wet processing, the coconut milk is extracted from the fresh kernel, which is then fermented naturally (at 35–40°C for 16–24 h) to obtain VCO from coconut curd by phase separation. The meal is milled into coconut flour (Yalegama et al., 2013). The solvent extraction method is generally avoided because of health hazards and lowquality meals (Wolf,1992). Usually, the meal or the residue obtained after the extraction of coconut oil is used as cattle and poultry feed (Karandeep et al., 2019).

Properties of coconut flour

Like wheat flour, coconut flour is a white or off-white flour commonly used in baking. Slightly nutty in odor; it has less coconut flavor (almost bland taste)due to reduced fat content. Coconut flour has a shelf-life of six months at room temperature. Since it doesn't contain gluten, people on gluten-free diets can substitute coconut flour in their recipe for baked goods.

Coconut flour is sub-classified according to its fat content (low, medium and high), protein content (high protein) and fiber content (high fiber). Being a rich source of dietary fiber and protein, it has found numerous applications in different functional foods (Karandeep et al., 2019). Coconut flour can be successfully incorporated into various food products, such as bakery, extruded products, snacks, and sweets (Karandeep et al., 2019). Non- starch polysaccharides (NSP) or dietary fiber are protective against gastrointestinal cancer, including esophageal ones (Karandeep et al., 2019).

Uses of coconut flour

Although coconut flour can be used as a substitute for wheat flour, many recipes must be adjusted to account for its different compositions. Coconut flour is thicker than wheat flour and retains more liquid.

Because it is gluten- free, doughs made with coconut flour need to be mixed longer. Coconut flour as a substitute for wheat flour in bread and cakes provides the limiting amino acids in wheat flour. This can be used in nutrition feeding programs. As a food supplement/additive in bread, cookies, snack food to provide dietary fiber sources, this can be used as fiber food to help in preventing constipation, as fiber food for patients with diabetes and moderately raised cholesterol levels. It is time now to promote the use of coconut four in different food products. Different recipes from coconut flour are needed for increased consumption and improved health by populations (Karandeep et al., 2019).

Bakery products including cereal-based cookies, bread, and crackers account mainly for an energy source in human nutrition; therefore, they are good vehicles for supplementation nutrients (Wani et al., 2012). Gunathilake et al. 2009 used coconut flour in different proportions (10, 20, and 30%) for refined wheat flour bread to enhance proteins, amino acid profile, and dietary fibers. Cereal proteins are not a valuable source of lysine (Panghal et al., 2006).The mixing behavior of the wheat flour and coconut flour blends were analyzed. It was found that water absorption decreased while dough development time, arrival time, and stability increased with 20% substitution. The study concluded that acceptable quality of bread could be made by 20% substitution of the wheat flour with coconut flour.

Nutritional composition of coconut flour

Compared to wheat flour, coconut flour has more fat, protein, and fiber. Iron is the primary mineral present in coconut flour, making it a good option for people on vegan or vegetarian diets who are concerned about getting enough iron.

The composition of coconut flour mainly depends upon the method employed for the extraction of coconut oil. However, varieties and agroecological zones have a slight influence on the oil content of coconut and, thus, on flour. Coconut flour is superior to wheat flour in protein, fiber, mineral, and lipid profile (Gunathilake and Abeyrathne, 2008.). Results from Khan et al., 2015 showed that coconut flour composition obtained by dry processing method was: moisture, 6.7%; ash, 1.55%; protein, 14.3%; fat, 54.0%; fibre, 20.50%; and carbohydrates, 23.40%. While Igbabul et al.,2014 found that the composition of coconut flour made by wet method had 5.27% moisture; 2.76% ash; 12.31% protein; 0.48% fat; 11.81% fibre; and 67.37% of carbohydrates. Thus, it is suggested that coconut flour produced by dry processing is rich in protein and fiber.

The general composition of coconut flour is 3.6% moisture, 3.1% ash, 10.9% fat, 12.1% protein, 60.9% total dietary fiber (56.8% insoluble and 3.8% soluble) and 70.3% carbohydrates.

Health benefits of functional coconut flour

Functional food is any food that imparts a positive effect on people's health and provides essential nutrition. Coconut flour has lower glycemic index rating than wheat flour, that it takes longer to digest and absorb carbohydrates. It also contains more fiber and protein than wheat flour (Yalegama et al., 2019). Dietary fiber is the best ingredient to be used in developing functional foods due to its health-promoting effects, such as controlling cholesterol and blood sugar levels, increasing the fecal bulk volume, proliferation of gut microflora, decreasing intestinal transit time, trapping carcinogenic agents, etc. Fiber can be supplemented using coconut flour to develop healthy foods low in calories and fats. Coconut flour is a potential functional ingredient used in food products with wide health benefits such as Antidiabetic effect; Cardiovascular diseases prevention; Anticancer effect; Weight control; Prebiotic; immune modulator; lowering glycemic index and serum cholesterol levels (Karandeep et al., 2019). Coconut flour can be considered a good substitute for gluten-free products and other processed products due to the absence of an antinutritional factor (Wolf WJ, 1992). Antinutrients lower the bioavailability of minerals and inhibit the protein digestion. Gluten- free food products enriched with coconut flour are a healthy and viable option for people with celiac disease.

Future perspectives of coconut functional flour

The production of coconut flour is very economical because it can be produced on a small or large scale.The functionality of coconut flour in terms of prevention for chronic diseases, e.g., diabetes mellitus, cardiovascular diseases (CVD) and colon cancer, reveals increased production of coconut and coconut flour. The increase in health consciousness by the population following post-pandemic COVID-19 can lead to increased consumption of healthy foods, including coconut flour. Modern lifestyle improved living standards, and changing eating habits can lead to a vast market of snacks. A serving of coconut provides 61% of dietary fiber. Overall, coconut flour is an excellent alternative for a gluten-free and grain-free diet.

Conclusion

Coconut meal obtained from the extraction of virgin coconut oil can be used in coconut flour as it is nutritious and a good source of proteins, minerals, and dietary fiber. Coconut flour made from coconut meals promotes health and prevents diseases like diabetes, obesity, colon cancer, and cardiovascular diseases. The flour can be used in the preparation of gluten-free products for individuals with celiac disease. The use of coconut flour aims to incorporate dietary fibers and proteins into gluten-free food.

Coconut flour is an underutilized product of the coconut industry, and its present use is minimal. There is an immense need for commercial processing techniques to enhance the utilization of coconut flour from coconut meals. Coconut flour extruded products will be convenience products with nutritional and health benefits. Coconut flour is a high protein, fibre-rich, and gluten-free functional food product.

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Source: Cocoinfo International Vol: 29 No:1, 2022

** Paper presented in the 49th International COCOTECH Conference*

Good Agricultural Practices for coconut in India:

Technological options, field scenario and strategies

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Good Agricultural Practices (GAP) are a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability (FAO, 2016). It has been well documented that implementation of GAP encourages promotion of the optimum use of resources such as pesticides, fertilizers, water, and eco-friendly agriculture. In addition, implementing GAP also helps promote sustainable agriculture and contributes to meeting national and international environmental and social developmental objectives. Coconut (Cocos nucifera L.) is an important plantation crop of India with a profound influence on the rural economy by supporting the livelihoods of substantial number of farm families. It not only contributes to the national agrarian economy, it also supports the subsidiary industrial development. In India, the coconut palm is mainly grown in ecologically sensitive geographical areas such as coastal belts, hilly areas and areas with high rainfall and humidity. Coconut is highly amenable for product diversification and is mostly used as a food crop and hence, apart from ensuring sustainable on farm production practices, efforts are also needed for adopting recommended post production practices to achieve food safety standards for the production and marketing of coconut products. In these circumstances, it is highly relevant to evolve and put into practice the set of recommendations on Good Agricultural Practices pertaining to coconut. Research carried out by ICAR- CPCRI and State Agricultural/Horticultural Universities has resulted in substantial number of technologies for coconut aimed at increased productivity, sustainability and increase in income which could finally improve the socio economic status of the farmers and other stakeholders. Recommended coconut production technologies appropriate to the agro-ecological situations in line with the GAP requirements are to be promoted among the farming community.

Similarly, post production practices as per the GAP requirements also to be evolved and applied to the coconut based enterprises to ensure safe and healthy food and non-food coconut products, while taking into account economic, social and environmental sustainability.

Coconut palm is a perennial crop which is committed to land for more than 60 to 100 years and thus it is important to promote sustainable production and processing technologies ensuring conservation and utilisation of natural resources without any exploitation to withstand both biotic and abiotic stress in an uninterrupted longer period of time in the existing climate change scenario. Hence the good agricultural practices for coconut would ensure holistic approach taking into account the plant, animal, environment and human health aspects in an integrated manner.

This paper broadly discusses technological options, field scenario and strategies for promoting Good Agricultural Practices for coconut in India which includes different aspects of ideal site selection, production of good quality planting materials, planting and after care. water management, nutrient management, soil and moisture conservation, cropping /farming system, pest and disease management, harvesting and product diversification.

Site selection

Good agriculture practices for coconut cultivation start with the selection of ideal site to ensure congenial physico-chemical properties of soil and ideal biotic and abiotic factors for sustainable productivity. Ideally coconut prefers level land for cultivation. However, in areas of undulated topography suitable soil conservation measures should be adopted according to the slope of the field to conserve natural resources and ensure sustainable production. The proposed site should have an elevation within the range of 600 m above mean sea level, mean temperature of 27±5°C with relative humidity ranging between 60 to 90 per cent, a well distributed rainfall of about 1300 to 2300 mm per year and about 2000 hrs of sunshine in a year. Loamy soils are ideal with the soil pH in the range of 5.5 to 7.5 with proper drainage, permitting unrestricted root development, aeration and absence of rock or a hard substratum within 2 m of the surface. The selected site for planting coconut should be free from chances for water and soil contamination. The field should be free of thrash, papers, plastics and empty containers.

Suitable Varieties

Since coconut is committed to land for longer period of time, selection of suitable varieties according to the location is one of the essential parts of GAP. The best GAP in this regard should be locally adapted varieties that are tolerant to both abiotic and biotic stress. If enough natural resources are available then hybrid varieties shall be selected for efficient utilization of them. More than 50 varieties and hybrids have been released through the sustained research efforts of ICAR-CPCRI and State Agricultural/Horticultural Universities to meet the diverse requirements viz., high copra and oil content, high tender nut water content and quality, suitable as dual purpose (copra and tendernut) variety, neera, ball copra, drought resistant, pest and disease resistant varieties. Hence the farmers have to give due attention for selection of suitable varieties.

Selection of Seedlings

Owing to long perennial life, procurement and planting of quality planting material is an important component of GAP in coconut. Seedlings should be procured from reliable resources viz., ICAR-CPCRI, State Agricultural Universities, governmental agencies including CDB and state department of agriculture and horticulture, accredited nurseries, approved community nurseries etc. Farmers also can raise own seedlings following the standard protocols prescribed in coconut nursery manual. To improve the veracity of the procured seedlings QR code shall be adopted. ICAR CPCRI introduced QR coded tags in the coconut planting material which help the farmers to decode them to ensure the variety details and authenticity of seedlings.

In tall varieties, vigorous seedlings which are one year old, more than 100 cm in height with 5-6 leaves and girth of 10 cm at the collar should be selected for planting. In dwarf varieties, the girth and height of good quality seedlings should be more than 8 cm and 80 cm, respectively. Early splitting of leaves is another character preferred for selecting good seedlings. Generally, one year old seedlings are preferable for planting. Similarly in the areas with a high wind velocity planting of 8 to 9 months old seedlings is preferable. It is always advisable to plant poly bag raised seedlings as it facilitates early establishment, precocious bearing and avoid transplanting shock. Polybag seedlings should be enriched with Keram micorrhizeae and Kera probio PGPR at the rate of 25g

per bag. Another advantage of polybag seedling is that the planting time could be adjusted depending upon the requirement.

Planting

Preparation of land for planting coconut depends to a large extent on soil type and environmental factors. If the land is uneven and full of shrubs, the shrubs have to be cleared and land should be leveled before digging pits. The depth of pits depend upon the type of soil. In laterite soil with rocky substratum, deeper and wider pits, 1.5 m length x 1.5 m breadth x 1.2 m depth may be dug and filled with loose soil, powdered cow dung and ash up to a depth of 60 cm before planting. In case of laterite soil, application of 2 kg of common salt will help in loosening the soil. In loamy soils with low water table, planting in pits of 1 m x 1 m x 1 m filled with top soil to a height of 50 cm is generally recommended. The seedlings are planted in the centre of the pit by making small holes within the pits and the soil around the seedlings must be firmly pressed, but soil should not be allowed to bury the collar region of the seedling or enter into the leaf axils. However, when the water table is high, planting at the surface or even on mounds may be necessary. While planting on the surface or mounds also, digging pits and soil filling has to be done. While filling the pits with soil, it is advisable to use top soil. Two layers of coconut husk (with concave surface facing up) can be arranged at the bottom of the pit before filling up. This will help in conserving the moisture. The seedlings, after field planting, are to be protected from heavy wind by staking and from sunlight by proper shading using plaited coconut leaves or palmyra leaves or any other suitable shading materials. On any account spindle leaf should not be continuously submerged in water that would lead to decaying of spindle leaf and death of the seedling. Care should be taken to avoid any physical and mechanical injury to the seedlings to avoid pest/disease disease incidence.

Spacing

Farmers should take care for providing optimum spacing while planting coconut which ensure maximum sun light falling on the leaf surface and leads to higher photosynthetic activity. For realizing better yield from coconut, optimum plant density must be maintained in the field. In general a spacing of 7.5 m x 7.5 m to 8.0 m x 8.0 m in the square system is generally recommended for coconut. This will accommodate 177 and 156 palms per ha, respectively. If the triangular system is adopted, an additional 25 palms can be planted. For facilitating multiple cropping simultaneously with the time of planting in coconut gardens, it is advisable to go for wider spacing of 10 m x 10 m so as to provide ample opportunity to accommodate a number of perennial and annual crops in the interspaces.

Replanting/ Under planting

Senile and unproductive palms should be removed and replanting should be done systematically with quality seedlings of chosen varieties. If under planting is preferred instead of replanting, peg marking should be done in between two rows of coconut palms and pits are to be dug at the centre of four palms. At any cost under planting of seedlings near the basins of existing palms should be avoided.

Time of planting

In well drained soils, seedlings can be transplanted with the onset of southwest monsoon during June or with the onset of north east monsoon during October-November. In low lying areas subject to inundation during monsoon periods, it is preferable to plant the seedlings after the cessation of the monsoon and preferably by making raised mounds.

Management of juvenile palms

Adequate care should be taken during the early years of growth of young palms for realizing high yield. The field planted seedlings should be shaded and irrigated adequately during the summer months. Drip irrigation should be practiced and water should be applied to meet the requirement of 66 per cent of open pan evaporation. During monsoon, pits should be protected by making the bunds at a height and width of 1x1 feet to prevent the entry of runoff water into the pits. The pits should be cleared of weeds periodically. Soil washed down and covering the collar region of the seedlings during the rainy days should also be removed. The pits should be widened every year before the application of manure. The pits should be gradually filled up as the seedlings grow. By fourth year, the basin should be fully prepared to a radius of 1.8 m from the trunk. The palms should be frequently examined for any insect or fungal attack and necessary remedial measures should be taken up promptly.

Inter cultivation

The aim of good agricultural practice in coconut with reference to inter cultivation is to ensure cleanliness of plot with minimum tillage practice. In the case of leveled lands two ploughings in a year should be practiced. The first ploughing i.e., summer ploughing should be undertaken immediately after the receipt of pre monsoon showers. This will ensure percolation of rain water and avoidance of runoff. This will also facilitate to expose all stages of pests to upper layer of the soil to be eaten by the predators. The second ploughing should be under taken towards the fag end of monsoon season. This ploughing helps in control of weeds, breaking of capillary pores and prevents the evaporation losses. While ploughing care should be taken to avoid mechanical injury of trunk. It is advisable to plough the land 1 m away from the trunk. Similarly, care should be taken to avoid damage to leaves while ploughing. In the case of undulated lands weeding can be done by brush cutter twice in a year. While ploughing driver of the tractor should take proper care by covering his face with mask to prevent the entry of finer soil particles through his nose that would invite lungs related problems, skin disorder etc.

Nutrient Management

Regular manuring right from planting is essential for good vegetative growth, early flowering, bearing and high yield of coconut palms. Once started, flowering is continued at 20-30 days interval till the end of lifecycle of coconut. Since vegetative and reproductive stages exists simultaneously there is no critical period for nutrients and water. Hence the good agricultural practice for nutrition of coconut should aim to supply plant nutrients regularly throughout the year. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided. Similarly leaf samples also need to be collected and tested once in three years.

Integrated nutrient management

Balanced and integrated nutrient management is the good agriculture practice for nutrition of coconut. Organic manures and chemical fertilizer should be applied based on soil test values.

Application of chemical fertilizers

Ensure manuring should be undertaken under optimum soil moisture conditions. Under rain fed conditions where unimodal rainfall distribution pattern is observed application of chemical fertilizer should be undertaken twice in a year, whereas 3-4 times application of chemical fertilizer is preferred under bimodal rainfall distribution. The first application of chemical fertilizer should be done three months after planting and the quantity of fertilizer to be applied is approximately one tenth of the recommended dose of fertilizer for adult palms.

During the second year, one third of the dosage recommended for adult palms may be applied in two split doses in May-June and September-October. This dosage may be doubled during the third year. From the fourth year onwards, fertilizers may be applied at the rate recommended for adult palms. Fertilizers may be applied in two split doses for the rainfed palms. After the receipt of summer showers, when the soil pH is acidic 1 kg of dolomite or agricultural lime should be applied within the radius of 1.8 m and forked in. Agricultural lime is a soil amendment used to conditioning the soil by raising the pH level. It is made from crushed limestone that contains natural nutrients to promote healthy plant growth. When lime is added it dissolves and releases a base that counteracts or neutralizes the soil acidity. After an interval of 15-30 days one-third of the recommended dose of fertilizers may be spread around the palms and forked in.

The second dose of chemical fertilizer along with recommended dose of organic manures should be applied towards the fag end of monsoon season. In areas which are benefitted by south-west monsoon the ideal time is second fortnight of August to first fortnight of September. In areas which are benefitted by north-east monsoon manuring should be undertaken during second fortnight of October to first fortnight of November. While applying fertilizers workers should be properly sensitized about wearing mask and gloves, usage of correct quantity, identification of chemicals and correct sequence of application.

In case of irrigated gardens nutrients may be applied in 4 equal splits through soil application. GAP for application of chemical fertilizers should be through fertigation at monthly interval. The water soluble fertilizer Urea and MOP are to be applied through fertigation. In the case of high rainfall zone fertigation shall be started from November and ended during May. In the case of low to moderate rainfall areas which lie in east coast and interior parts of Tamilnadu and Andhra Pradesh the fertigation can be given 10-12 doses in a year.

Since phosphorus is highly immobile in the soil and water soluble phosphorus immediately fix in the acidic pH that necessitates the source of phosphorus for acid soil is rock phosphate (acid soluble phosphatic fertilizer). When the soil pH is 7 and above the source of P should be met from water soluble phosphatic fertilizer viz. single super phosphate, Di ammonium phosphate, triple super phosphate etc. Phosphatic

fertilizer shall be applied through soil application. When the soil available phosphorus reaches more than 20 ppm, phosphorus application can be skipped. Accumulation of higher level of phosphorus reduces the uptake of zinc.

Organic manuring

Organic manuring is an important part of GAP for coconut nutrition. The source of organic manure could be green manure, green leaf manure, animal manures, concentrate and compost. Green manuring involves cultivation of leguminous plants having symbiotic association with efficient *Rhizobium* strains in coconut basins and interspaces during the monsoon period and incorporation of biomass generated to the palms at the maximum vegetative growth stage of legumes. Growing of leguminous green manure crops in the basin of adult coconut plantations and incorporation of biomass generated resulted in substituting nitrogen fertilizer for coconut up to 30 per cent. Besides incorporation of green manures improve soil physical, chemical, biological properties. It reduces the weed growth and runoff. Suitable leguminous species for green manuring in the coconut garden are *Pueraria phaseoloides*, *Mimosa invisa*, *Calopogonium mucunoides*, cowpea (*Vigna unguiculata*), sunhemp (*Crotolaria juncea*), horse gram (*Macrotyloma uniflorum*), daincha (*Sesbania aculata*) and *Sesbania spinosa* etc. It contribute about 15-25 kg of biomass and 100-200 g of nitrogen in coconut basins during a growth period

of 60-120 days in monsoon season.

Pelleting of inoculated seeds with neutral or inert materials enhances nodulation by introduced *Rhizobia* in acidic soils. Once it attains 50 per cent flowering stage the crop may be incorporated in the basin and over that recommended chemical fertilizers could be applied. Perennial green manure crop glyricidia could be planted along with the border of the coconut gardens and it can be pruned at the interval of once in three months.

Similarly animal manures namely farm yard manure, poultry manure or goat manures could be used for organic nutrition in coconut. The animal based manures should be decomposed properly and the C: N ratio should be less than 12:1. The normal composting period may range from 3 to 5 months. Compost, vermicompost and coir pith compost are excellent sources of organic nutrition for coconut. Among these vermicompost produced from coconut leaves is the ideal one. Coconut produce 4-6 tones of dried coconut leaves and this could be effectively converted into vermicompost by utilizing earth worms.

Coir pith is a by product which is obtained after the extraction of coir from the husk. Coir pith can turn into effective organic manure by mixing with poultry manure. Technologies for large scale composting of coir pith has been standardized at ICAR-CPCRI with amendments like poultry manure, lime and rock phosphate @ 10 kg, 0.5 kg and 0.5 kg, respectively for every 100 kg of coir pith as well as inoculation of biopolymer degrading micro organisms at 0.2 % level. Pleurotus spp. has the capacity to degrade part of the cellulose and lignin present in coir pith by production of enzymes viz., cellulases and lactases (George V Thomas 2018) Concentrated organic manures namely, oil cakes (Ground nut, gingelly, coconut, pongamia, neem), fish manure could be used as organic manure.

In order to reap the full benefits of organic manures, care should be taken for ensuring the proper method of application of organic manures. The time of organic manure application should be towards the end of monsoon season to ensure optimum moisture for effective composting and nutrient availability to the coconut palms. For this circular basin of 1.8 m radius and 20 cm depth may be dug during August-September (areas benefitted from south west monsoon) and October November (areas benefitted from north east monsoon) and green leaf or compost or farm yard manure or bio gas slurry or coir pith compost or vermicompost or goat manure or poultry manure may be applied in the basin at the rate of 50 kg per palm. Green leaf manures, compost and vermicompost can be applied as fresh manure. The remaining dose of chemical fertilizers may be applied by broadcasting and a thin layer of soil put to cover the fertilizer materials.

After 10 days 5 kg of neem cake fortified with 100 g of trichoderma may be applied along with the organic manure. Biofertilizer formulations of nitrogen fixing bacteria, *Azospirillum brasilense* and phosphate solubilising bacteria, *Bacillus subtilis* can be used as inputs in organic coconut cultivation as soil application @ 100 g per palm per year along with organic amendments. '*Kera Probio*', a talc formulation of *Bacillus megaterium*, effective for raising robust coconut seedlings has been developed at ICAR-CPCRI. Similarly an *Arbuscular Mycorrhizal Fungal* (AMF) bioinoculant, 'KerAM', has been developed which is a soil based AMF bioinoculant for coconut seedlings. It is always advisable to use location specific consortia.

Care should be taken to use only biofertilizers containing adequate number of living micro organism and before the expiry period mentioned in the packet. It has been observed that in many instances desired results are not obtained due to the use of preparations not containing the required number of metabolically active micro organisms.

Since manure pit is the breeding site for the rhinoceros beetle care should be taken to prevent the entry of rhinoceros beetle in to the manure pits. The manure pit should be properly covered with nylon mesh. Undecomposed farm yard manure should not be put as heap in the garden. Wherever irrigation facilities are available, it is advisable to go for more number of split doses, preferably four split doses (March, June, September and December). Manuring should be avoided during rainy days and when there is lack of moisture in the soil.

Lack of availability of good quality organic manure is a constraint experienced by coconut growers. This situation is exploited by unscrupulous elements by supplying adultearated inferior quality organic manure. Hence, to the extent possible composting should be done in the coconut garden itself by utilizing the biomass available such as coconut leaves, weed material etc. Burning of organic materials should be

avoided instead they can be used for mulching and composting.

Irrigation and water management

Drip irrigation as a water saving method of irrigation assumes much significance as a component of good agriculture practices for water management in coconut. Drip irrigation having high water use efficiency saves water, energy and labour. Drip irrigation is a micro irrigation system in which the water is applied to the root zone at the rate at which the palm can take up. Four pits with a size of 30 x 30 x 30 cm have to be dug one meter away from the bole of the palm at equidistance and the pits filled with raw coir pith. The water has to be delivered to the pit through conduit tube placed in slanting position. Based on a study conducted at ICAR- CPCRI, it was concluded that yield of coconut with drip irrigation daily @ 66% of the Eo was adequate. Thus, there is 34 per cent saving of water in drip irrigation. This is applicable to all coconut varieties including hybrids and also for different soil types. The number of dripping points should be six for sandy soils and four for other soil types. The rate of water application should be 2-4 litres per hour per emitter. The timing of drip irrigation recommended is from November to May at monthly interval in the areas where south west monsoon is benefited. After the end of the post monsoon season when the available soil moisture reaches more than 50%, drip irrigation should be commenced. Mulching should be invariably practiced to extract the full benefits of drip irrigation. Irrigation can be applied throughout the year in the east coast region and interior parts of Tamil Nadu and Andhra Pradesh. Wherever coconut based cropping system is practiced sprinkler of perfo irrigation may be undertaken.

Soil and moisture conservation measures in coconut

In the GAP concept, it is advisable to use *insitu* moisture conservation measures by collection, conservation and judicious utilization of water resources. This will help to reduce soil erosion and improve the nutrient availability. In order to conserve soil moisture in the coconut plantation, mulching with various types of organic materials viz., coconut leaves (in two to three layers), husk (in two to three layers- 250 to 300 husks/basin) and coir pith (10 cm thickness -approx. 50 kg/palm) can be practiced which helps to reduce soil temperature and evaporation from soil surface and create conditions for proper root growth and proliferation of soil flora and fauna. The best time for mulching is before the end of the monsoon and before the top soil dries up.

Coconut husk burial in layers with the bottom layers facing up and top layer facing down, in the trenches (50 cm width x 50 cm depth and convenient length) dug out in the interspace of coconut will also helps in soil moisture conservation. Half-moon bund around coconut basin reinforced with two rows of pineapple- this measure can also be taken up where ever there is mild slope (15-20%) of land. Here the bund prevents runoff and water gets collected within the basin and percolates down. Pineapple would help to protect the bund and stabilize the same in addition to giving fruit yield. If the land is highly sloped then trenches of 50 cm width x 50 cm depth and convenient length would be made in between two rows of coconut palms and filled with coconut husk and bunds should be stabilized with crops like pine apple. One can go for catch pits also. Though there is no standard dimension for catch pits, we may go for catch pits of 1.5 m length x 0.5 m width x 0.5 m depth with a bund at the downstream. This pit also may or may not be filled with coconut husk. ■

Will be continued in the next issue

Coconut Oil: A Unique Oil With More Than Hundred Uses

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The coconut palm produces a fruit that has more than a thousand uses. This coconut fruit contains a nourishing drink and a highly nutritious coconut meat.

The dry coconut meat is a complete natural food: proteins (7%), carbohydrates (22%), fiber (16%) and oil (56%) (USDA Food Data Central, 2022). In addition to its food uses, the coconut fruit has over a hundred other non-food uses (Coconut Products, 2011).

This article focuses on the nutritional benefits of coconut oil, which has been used by people in the tropics for millennia in more than a hundred ways.

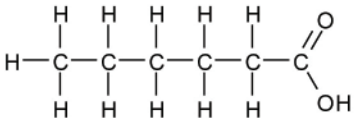
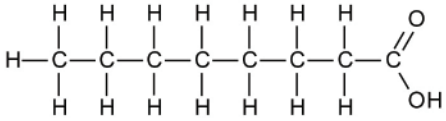
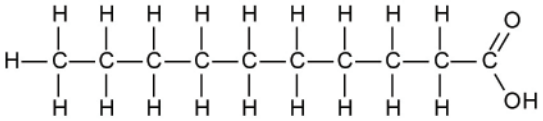
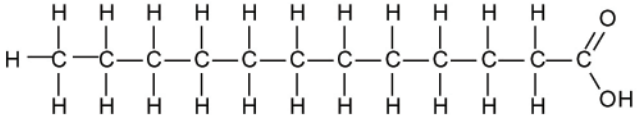
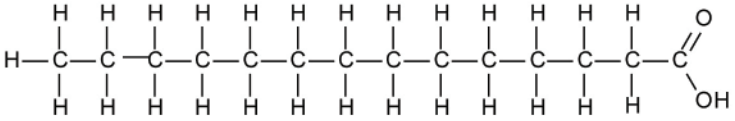
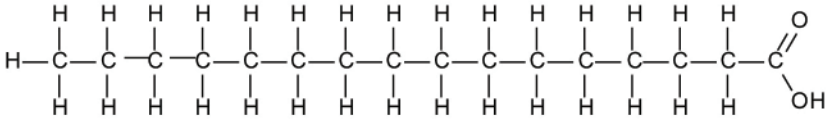
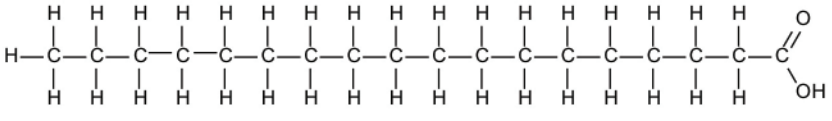
What is Coconut Oil?

Coconut oil makes up more than half of the weight of coconut meat on a dry basis (about 35% on a fresh weight basis). Consuming coconut meat with meals or as part of a recipe means that one will be able to ingest coconut oil in the meal. Coconut oil is often extracted from the coconut meat to make virgin coconut oil (VCO) or refined coconut oil which is used for frying.

Coconut oil, like other seed oils and animal fats, is made up of natural compounds called fatty acids, which are among the most fundamental biochemicals found in all organisms, from microorganisms to plants and animals. Fatty acids are compounds that are made up of a linear chain of carbon atoms. The fatty acids of common fats and oils are shown in Table 1. Although the structures of the fatty acids look very similar, they can be differentiated in two ways: by the number of carbons and by the number of double bonds (or the degree of unsaturation).

Based on the number of carbons, fatty acids can be classified into medium-chain (six to twelve carbon atoms) and long-chain (fourteen to eighteen carbon atoms). Based on the presence of double bonds, fatty acids can be classified into saturated (no double bonds), mono-unsaturated (one double bond), omega-6 (18 carbon atoms with two double bonds), and omega-3 (18 carbon atoms with three double bonds). This classification is based on the physico-chemical properties of these fatty acids, as well as their metabolic properties. The significance of these properties with respect to the health effects of the various fats and oils is discussed below.

Different fats and oils have their characteristic fatty acid compositions (Table 2 and Figure 1) and their fatty acid compositions determine their

Name and Structure	Classification
Caproic acid, C6:0 	Saturated Medium-chain
Caprylic acid, C8:0 	Saturated Medium-chain
Capric acid, C10:0 	Saturated Medium-chain
Lauric acid, C12:0 	Saturated Medium-chain
Myristic acid, C14:0 	Saturated Long-chain
Palmitic acid, C16:0 	Saturated Long-chain
Stearic acid, C18:0 	Saturated Long-chain

health effects. Coconut oil is a predominantly saturated oil, with a composition that is about 63% medium-chain saturated, 28% long-chain saturated, and about 9.5% unsaturated. One can therefore classify coconut oil as "medium- chain saturated".

Animal fats are not saturated fats

Animal fats, in particular butter, pork and beef fat, have been labeled as "saturated fats" by the American Heart Association (2021). However, the proportion of their fatty acid content show them to be less than 50% saturated fat by weight. In thecase

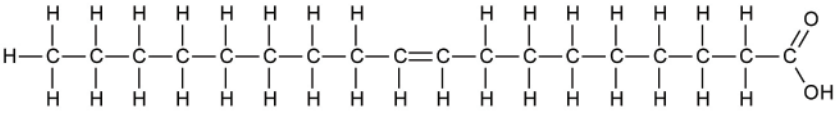
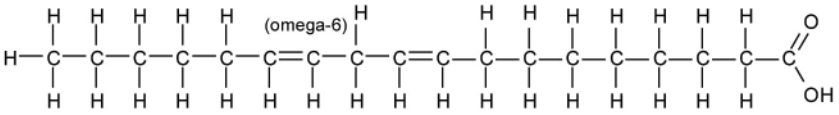
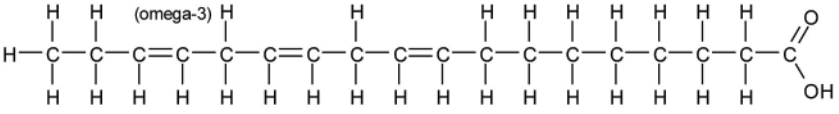
Name and Structure	Classification
Oleic acid, C18:1 	Mono-unsaturated Long-chain
Linoleic acid, C18:2 	Omega-6 Long-chain
Linolenic acid, C18:3 	Omega-3 Long-chain

Table 1. The fatty acids of common fats and oils and their classification. The short-hand designation of a fatty acid indicates the number of carbon atoms and the number of double bonds. For example, lauric acid is designated as C12:0 and linoleic acid is C18:2.

Classification	Fatty acid	Coconut oil	Corn oil	Olive oil	Palm oil	Soybean oil	Butter	Lard, Pork fat	Tallow, Beef fat
Saturated, Medium-chain	Capoic C6:0	0.4					1.6		
	Caprylic C8:0	7.0					0.9		
	Capric C10:0	6.3					2.0	0.1	
	Lauric C12:0	49.0	0.2		0.3	0.1	2.3	0.2	0.9
Saturated, Long-chain	Myristic C14:0	18.9	0.2	0.1	1.0	0.1	8.2	1.3	3.7
	Palmitic C16:0	7.0	12.6	13.8	40.8	10.8	21.3	23.8	24.9
	Stearic C18:0	2.0	1.7	2.8	4.3	3.7	9.8	13.5	18.9
Mono-unsaturated	Oleic C18:1	7.5	31.1	69.0	41.6	23.5	20.4	41.2	36.0
Omega-6	Linoleic C18:2	1.8	49.8	12.3	11.8	53.5	1.8	10.2	3.1
Omega-3	Linolenic C18:3	0.1	1.0	1.5	0.3	7.8	1.2	1.0	0.6
Others: Cholesterol mg/kg		≤3	0.2-0.6	<0.05	2.6-6.7	0.2-1.4	219	95	109

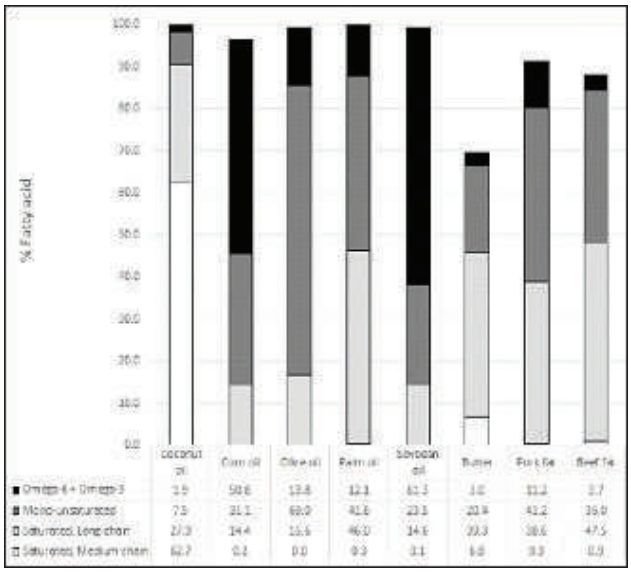


Figure 1. Fatty acid profiles of some common fats and oils. See Table 2 for specific fatty acid composition. This plot visually shows that coconut oil has a unique fatty acid profile that is medium-chain saturated (clear bar).

of pork fat, there is more unsaturated fat than saturated fat by weight (Figure 1). Thus, the claim that all animal fats are the same and that they are all saturated are incorrect. In addition, animal fats contain high amounts of cholesterol. Therefore, to put coconut oil and all animal fats in the same category is clearly erroneous.

When the AHA in 1961 first declared that animal fats were "saturated fats" and similar to coconut oil, the AHA did not provide any scientific data to support this classification (Page et al., 1961), despite the availability of suitable chemical methods of analysis. The only physical property which coconut oil and animal fats share is that they are solid, but at the colder temperatures of the temperate countries. This error was carried over in the Seven Countries Study headed by Ancel Keys, where all types of animal fats and margarine (trans fats) were considered as "saturated fat" (Keys et al., 1986). Thus, sixty years of dietary research have to be reassessed because of this erroneous definition of "saturated fat." And the various dietary guidelines that assume that all animal fats are saturated fats must likewise be reassessed.

Only coconut oil can be said to be truly saturated and as we see, coconut oil is one of the healthiest oils in the world.

The Dietary Guidelines for Americans (DGA) is the most important advisory on diet that is issued by the US government. The DGA was first issued in 1980, and it is reviewed every five years with the release of a new edition. A number of changes have been made since its first edition. Significantly, the warning against trans fats was added in 2005 (6th edition) while the advisory against cholesterol in the diet was dropped in 2010 (7th edition) when this was shown not to be supported by the data.

However, there are two things that have remained the same in the DGA since 1980: the warning to keep "saturated fat" low and the absence of a limit on unsaturated fat. Since "saturated fat" is defined erroneously, this warning is erroneous as well. On the other hand, the excessive consumption of linoleic acid has been identified as one of the causes of the epidemic of obesity among Americans. In particular, the amount of linoleic acid increased from about 10% of calories before 1980 increasing to 23% in 2008 (Guyenet & Carlson, 2015). The high linoleic acid in the diet, which is encouraged by the DGA, can be correlated with the epidemic of obesity among Americans, which was observed to increase in 1980 with the first edition of the DGA (US NIH, 2017). The increase in obesity in the US has been observed also in many countries that followed the advice of the DGA (Figure 2) (GBD, 2015).

This increase in obesity has also been observed among people in the South Pacific Islands. In 2003, the World Health Organization Regional Office for the Western Pacific noted that: "In 1998, it was determined that people were 2.2 times more likely to be obese and 2.4 times more likely to be diabetic if they ate imported fats than if they ate traditional fat sources," (WHO, 2003).

Unsaturated fats produce free radicals and aldehydes when heated

The chemical structure of the fatty acid determines its stability against oxidation: the more double bonds a fatty acid has, the easier it is to oxidize. The tendency to oxidize fatty acids follows the following trend: linolenic acid (C18:3) > linoleic acid (C18:2) > oleic acid (C18:1) >> saturated fatty acids. Seed oils which are highly unsaturated, such as soybean oil and corn oil, readily oxidize.

The oxidation of a fatty acid can take place by exposure to oxygen in the presence of high temperature and light. Storage of highly unsaturated oils leads to oxidative rancidity. Rapid oxidation happens when one heats such oils during frying. Oxidation leads to the formation of free radicals and degradation products such as peroxides and aldehydes. These compounds attack proteins and cell membranes and can lead to cellular damage, inflammation, obesity, diabetes, cancer and other diseases, such as Alzheimer's disease. In particular,

Composition of fatty acid profiles of selected vegetable oils

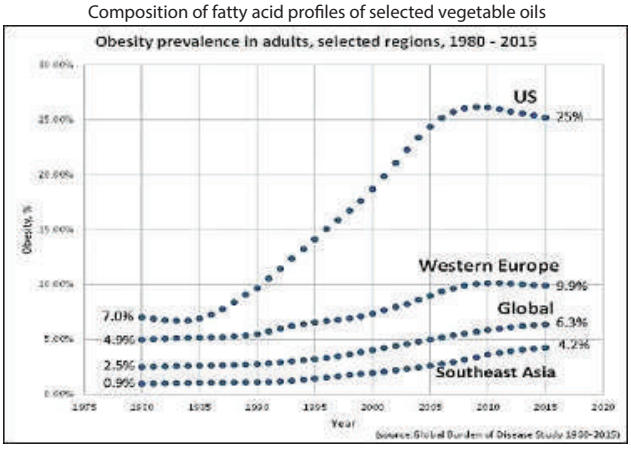


Figure 2. The prevalence of obesity has been increasing since 1980. The first edition of the Dietary Guidelines for Americans was published in 1980, and has been adopted by many other countries.

soybean oil, the most widely consumed oil in the US, has been linked to obesity and diabetes, and cause neurological conditions, such as Alzheimer's disease, anxiety, and depression (Deol et al., 2010). On the other hand, coconut oil, because it is a predominantly saturated fat (>90% saturated), is stable to oxidation and is therefore a healthy frying oil.

The rise of virgin coconut oil (VCO)

Codex Alimentarius defines virgin oils as oils that are obtained by mechanical methods and the application of heat, without altering the nature of the oil. (Codex Standards for Fats and Oils from Vegetable Sources, n.d.) The year 2000 witnessed the revival of interest in coconut oil with the rise of virgin coconut oil (VCO). Before the development of VCO, coconut oil was commercially available as edible oil, known as refined, bleached and deodorized coconut oil, and was used mainly as a frying oil. On the other hand, VCO found use as dietary supplement, salad oil, food ingredient, skin and hair care, moisturizer, massage oil, and other applications.

The world market for VCO has been projected to reach about USD 5 Billion by 2024 and its popularity has been rising steadily in various parts of the world. Unfortunately, as the value of VCO has increased in value, so also has the threat of adulteration. The most common adulterants of VCO are refined coconut oil and palm kernel oil. The development of tight product standards is essential to ensure the quality of VCO and advanced techniques, such as nuclear magnetic resonance (NMR) spectrometry, can be used to detect adulteration.

Beneficial properties of VCO

VCO has been widely reported to have numerous beneficial effects, in particular, for health and beauty. With the rapid rise in the use of VCO, many scientific studies have shown that VCO is beneficial for many things. A few are cited below:

• **VCO increases HDL.** In a study that compared VCO, virgin olive oil (VOO), and butter, VCO significantly raised HDL-cholesterol compared with VOO and butter but did not significantly raise LDL-cholesterol, as often reported in other studies. The surprising finding from this study was that there was no significant difference between VCO and VOO in terms of LDL- cholesterol and total cholesterol results despite their very different fatty acid profiles. (Khaw et al., 2018) This contradicts the claims of the AHA that VCO raises the risk of cardiovascular disease.

• **VCO can help lower obesity.** Unlike other seed oils which are made up mainly of long-chain fatty acids, VCO is a non-fattening oil because it is made up predominantly of medium-chain fatty acids which are not deposited as fat in the body. Consistent with this, VCO consumed moderately does not lead to obesity, and may even decrease obesity. The effects of dietary supplementation with coconut oil versus soybean oil on the biochemical and anthropometric profiles of women with abdominal obesity showed that coconut oil reduced waist circumference and improved lipid profiles of HDL-cholesterol (Assuncao et al., 2009).

• **VCO is antibacterial.** Numerous reports have been published on the antibacterial properties of lauric acid and monolaurin both in vitro and in vivo against Gram-bacteria and fungi. These compounds

are unique in their ability to avoid the development of microbial resistance which may be due to their multiplicity of action, which includes disruption of the cell wall and interference with cell signaling and transcription (Dayrit, 2015).

• **VCO is good for skin care.** VCO has been traditionally used as moisturizer by people in the skin by enhancing skin barrier function (Varma et al., 2019).

• **VCO is good for hair care.** Coconut oil has been shown to prevent combing damage of various hair types. A study comparing coconut oil, mineral oil, and sunflower oil showed that coconut oil reduced protein loss in both undamaged and damaged hair, while sunflower oil and mineral oil did not reduce protein loss from hair (Rele & Mohile, 2003).

VCO is effective against COVID-19

Coronavirus disease 2019 (COVID-19) is a respiratory disease that has caused significant morbidity and deaths worldwide for over two years. The first clinical on the use of VCO evaluated its efficacy in mild cases of COVID-19 against a control group. Overall, the VCO group experienced more rapid relief from symptoms of COVID-19 and a significantly higher reduction in mean C-reactive protein levels compared to the control group after 28 days. These results are consistent with the anti- viral and anti-inflammatory properties of VCO. This study showed that VCO is an effective, safe, and affordable treatment for mild COVID-19 infection (Angeles-Agdeppa et al., 2021).

Conclusions

Coconut oil is a unique oil with over a hundred uses which includes food and nutritional supplement with anti-obesity and anti-inflammatory activities, antibacterial and antiviral agent, and skin and hair care. Coconut oil is the most stable frying oil, which avoids health damage from the use of unsaturated oils. This brief review of coconut oil shows that it is perhaps the best oil that one can obtain from nature.the tropics. Clinical studies have shown that VCO improves the symptoms of skin disorders by moisturizing and soothing the skin. VCO suppresses inflammatory markers and protects

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Source: Cocoinfo International Vol: 29 No:1, 2022 * Paper presented in the 49th International COCOTECH Conference

Balanced Fertilization for Better Yields in Cocoa

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Cocoa (*Theobroma cocoa*) eulogized as 'Food of Gods' belonging to the family *Malvaceae* is characterized by three cultivar groups – Criolloa, Forastero and Trinitario. This crop known to the world since pre-Columbian times had initially been accommodated only in agro-forestry systems. Although cocoa was identified as an understorey rain forest, its cultivation has deep rooted within 100N and 100S of the equator. In India, cocoa is cultivated as an intercrop in coconut, oil palm, rubber and arecanut plantations over an area of 87,000 ha with a total production of 20,000 M.T. In Tamil Nadu, cocoa is cultivated across an area of 10,000 ha and the cocoa production is severely constrained by a string of factors of which the nutritional disorders especially due to micronutrients holds a great promise. Integrated Nutrient Management is a viable option to grow cocoa as a healthy crop in a sustainable way to compensate for the yield loss.

Cocoa requires deep and well drained soil for easy penetration of roots and better anchorage of roots. Optimum pH for cocoa cultivation is 6.5-7.0. Response of cocoa to fertilization was first published in research trials of Cameroon in 1910 followed by Java, Trinidad and Ghana. The functions of nutrients and deficiency symptoms of cocoa are portrayed here under.

(i) Nitrogen (N)

It is the Kingpin of the nutrient which is essential for the growth of the plant, production of flowers and for higher yields. Since cocoa is of cauliflorous nature, the fruits grow directly on the trunk and primary branches, while leaf production is concentrated in the apical branches. As N promotes vegetative growth, cocoa uses the products of photosynthesis to produce more branches at the expense of flowering and fruiting. Nitrogen deficiency is a perfect balance

Zinc deficiency in Cocoa

between soil poverty of nitrogen and the intensity of shade and is exacerbated in soils with high pH, poor organic matter and in regions of high rainfall. Nitrogen deficiency results in uniform chlorosis of older leaves as it is the highly mobile element in plant system.

(ii) Phosphorus (P)

Phosphorus is essential for energy transfer, nucleic acid formation, protein synthesis and carbohydrate metabolism. It is essential for root growth and for the maturity of beans. Cultivation of cocoa in calcareous soils results in phosphorus deficiency due to the fixation of applied phosphorus as calcium phosphate.

(iii) Potassium (K)

Potassium is essential for maintaining better leaf quality and for regulating the opening and closing of stomata. The nutrient imparts resistance to pest and diseases and a complexity of biotic and abiotic stress. Soils with low K reserves exhibit potassium deficiency in cocoa plants. Chlorosis spreads from the outer edges of the leaves and extends towards the base. With severe deficiency, leaf tips and margins show necrosis. Older leaves fall off and plants show terminal die back.

(iv) Magnesium (K)

Magnesium is the pivot of the porphyrin ring structure of chlorophyll molecule and is essential for photosynthesis. Magnesium deficiency results in yellowing of leaves and premature leaf fall. High levels of potassium and calcium in the soil can result in magnesium deficiency.

(v) Calcium (Ca)

Calcium is an essential component of the cell membranes resulting in structural integrity and is essential for pod development. Poor pod development and breakage of petioles is one of the symptoms of Ca deficiency.

(vi) Zinc (Zn)

Zinc is essential for the development of apical meristems and for internode elongation. Zinc deficiency is commonly witnessed in calcareous soils wherein zinc is fixed as $ZnCO_3$. In the event of zinc deficiency, leaves develop wavy margins and develop sickle shape. Chlorotic patches develop between the veins.

Zinc deficiency in Cocoa

(vii) Iron (Fe)

Iron is essential for photosynthesis and plant metabolism. Iron deficiency is commonly noticed in high pH soils and calcareous soils due to the fixation of iron as siderite. Interveinal chlorosis is the prominent symptom of iron deficiency and in advanced stages the leaves assume papery appearance.

Interface Programme for task force of FoCTs

Coconut Development Board organized an interface programme for task force of FoCTs and progressive coconut farmers in Alappuzha district, Kerala on 14th December 2022. The programme was organised in association with Gandhi Smaraka Grama Seva Kendram at S L Puram, Alappuzha, Kerala. Dr. Hanumanthe Gowda, Chief Coconut Development Officer chief guest of the programme interacted with selected Friends of Coconut Trees trainees who were trained at Gandhi Smaraka Seva Kendram and is presently carrying out group activities in coconut harvesting and other plant protection operations in Alappuzha district.

Shri. Rameshan, group leader of the FoCT briefed about the activities being undertaken by the task force. Progressive coconut farmers from Alappuzha district expressed the difficulties being faced in coconut sector. Dr. Hanumanthe Gowda, CCDO assured that CDB is planning to utilize Task Force of FoCTs in better way as part of implementation of CDB schemes on cluster basis for the benefit of farming community. Shri. Ravi Palathunkal, President, Gandhi Smaraka Grama Seva Kendram presided over the function. Smt. Mini Mathew, Assistant Director and B. Chinnaraj, Development Officer spoke during the occasion. Smt. Rema Ravindra Menon, Secretary, Gandhi Smaraka Grama Seva Kendram welcomed the gathering. Shri. Manu, Programme Officer, Gandhi Smaraka Grama Seva Kendram proposed vote of thanks.

Iron Chlorosis in Cocoa

Iron Chlorosis in Cocoa

Nutrient Management

For cocoa plants of economic bearing, 100-40-140 g NPK is recommended per plant per year. It is applied in two equal splits during May – June and December – January. As cocoa is a tap rooted perennial with a root zone spread of 150 cm from the trunk, fertilizer application should be done at a distance of 1 ft. from the trunk for one year old plant, 1 ½ ft. for 2 years and 1.5 m for plants of three years and more. The common nitrogenous fertilizers are urea, ammonium sulphate and ammonium chloride. Common sources of phosphorus are single super phosphate and DAP. Rock phosphate is not recommended for soils with high pH or calcareous soils. Muriate of potash and sulphate of potash are the commonly employed potassic fertilizers.

Micronutrient recommendation for cocoa is $FeSO_4$ – 100 g, $MnSO_4$ – 25 g, $ZnSO_4$ – 50 g, $CuSO_4$ – 25 g and Borax – 10 g per plant per year.

Foliar application of nutrients

In the event of acute iron chlorosis, 1 % $FeSO_4$ + 0.1 % citric acid is sprayed thrice at fortnightly interval to alleviate the problem. To overcome zinc stress, 0.5 % $ZnSO_4$ is sprayed thrice at fornightly intervals. Calcium deficiency may be managed by foliar application of 0.5 % $CaNO_3$. Magnesium deficiency can be controlled by foliar application of 1 % $MgSO_4$ ■

58th ICC Session and Ministerial Meeting

The 58th ICC Session and Ministerial Meeting of the International Coconut Community (ICC) chaired by the Government of Tonga were held during 28th and 30th November 2022. The meeting discussed the status of coconut cultivation and industry in the member countries and the way forward for the better prospects of the sector. Dr. Hanumanthe Gowda, CCDO, CDB made the Country Presentation – India during the occasion. Dr. Jelfina C Alouw, Executive Director, presented the Annual Report and updated the activities being undertaken by ICC. The programmes and activities proposed for the year 2023 was approved during the session. ICC Member countries and Observer Organisations like FAO, SPC, ACIAR, CIRAD, CABI, CARDI etc actively took part in the session.

Assam International Agri - Horti Show - 2022

Coconut Development Board, Regional Office, Assam participated in 7th Assam International Agri - Horti Show - 2022 scheduled during 17rd to 19th December 2022 at Veterinary play ground, Khanapara, Guwahati, Assam. Shri Parimal Suklabaiya, Hon'ble Minister of Transport, Fisheries and Excise, Assam visited CDB's Stall. Board displayed various informative posters on Board's schemes and on the goodness of coconut, publications of the Board. Various value added products viz tender coconut water, virgin coconut oil, chips, desiccated coconut powder etc were displayed in Board's stall.

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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.

▶ *Cocout 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.

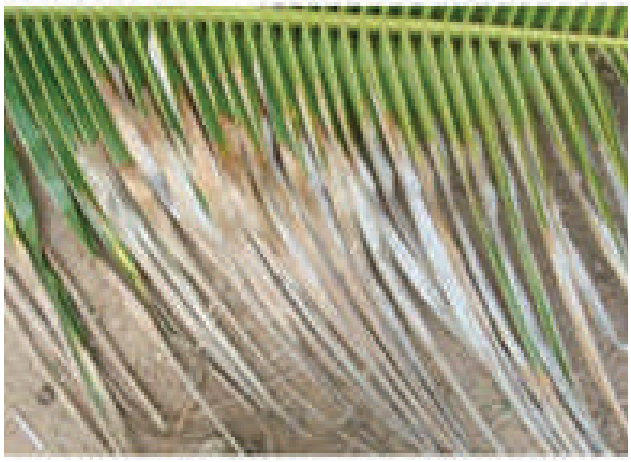
e) Application of recommended dose of fertilizers, recycling of biomass, raising of green manure crops in palm basin and incorporation during flowering, summer irrigation including soil and water conservation measures improve the palm health and reduce the pest attack.

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 nearlymature/maturenutswereinfected,theinfection 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 8 southern districts of Kerala starting from Thiruvananthapuram to Thrissur and in isolated patches in the remaining 6 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, CPCRI Regional Station, Kayamkulam)

Market Review – November 2022

Domestic Price

Coconut Oil

During the month of November 2022, the price of coconut oil opened at Rs. 13400 per quintal at Kochi and Alappuzha market and Rs. 13800 per quintal at Kozhikode market.

The prices of coconut oil closed at Rs. 14200 per quintal at Kochi and Alappuzha market and Rs. 15100 per quintal at Kozhikode market with a net gain of Rs. 800 per quintal at Kochi and Alappuzha market and Rs. 1300 per quintal at Kozhikode market.

During the month, the price of coconut oil at Kangayam market opened at Rs. 11467 per quintal and closed at Rs. 12400 per quintal with a net gain of Rs. 933 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.11.2022	13400	13400	13800	11467
05.11.2022	13500	13500	13850	11467
12.11.2022	13700	13700	14400	12000
19.11.2022	13800	13800	14600	11733
26.11.2022	14200	14200	15100	12400
30.11.2022	14200	14200	15100	12400

Milling copra

During the month, the price of milling copra opened at Rs.7700 per quintal at Kochi and Rs.7650 per quintal at Alappuzha and Rs.8250 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 9200 per quintal at Kochi market, Rs. 9150 per quintal at Alappuzha market and Rs. 9400 per quintal at Kozhikode market with a net gain of Rs.1500 at Kochi and Alappuzha market and Rs. 1150 per quintal at Kozhikode market.

During the month, the price of milling copra at Kangayam market opened at Rs.7800 and closed at Rs. 8500 per quintal with a net gain of Rs. 700 per quintal.

*NR-Not reported

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.11.2022	7700	7650	8250	7800
05.11.2022	8000	7750	8350	7800
12.11.2022	8500	8450	8700	8300
19.11.2022	8800	8650	9000	8300
26.11.2022	9200	9150	9600	8500
30.11.2022	9200	9150	9400	8500

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 13100 per quintal and closed at the same price.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.11.2022	13100
05.11.2022	12800
12.11.2022	12800
19.11.2022	12700
26.11.2022	13100
30.11.2022	13100

Ball copra

The price of ball copra at Tiptur market opened at Rs. 13000 per quintal and closed at Rs.12000 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)	
01.11.2022	13000
05.11.2022	13000
12.11.2022	12500
19.11.2022	12200
26.11.2022	12000
30.11.2022	12000

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs. 10750 per quintal and closed at Rs.10550 per quintal with a net loss of Rs.200 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.11.2022	10750
05.11.2022	10750
12.11.2022	10550
19.11.2022	10550
26.11.2022	10550
30.11.2022	10550

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs. 13000 per thousand nuts and closed at Rs 15000 per thousand nuts with a net gain of 2000 per thousand nuts.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 22000 per ton and closed at Rs. 25000 per ton with a net gain of Rs.3000 per ton during the month.

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

At Mangalore market in Karnataka, the price of coconut opened Rs. 28000 per ton and closed at Rs. 25000 per ton during the month with a net loss of Rs. 3000 per ton.

Weekly price of coconut at major markets				
	Nedumangad (Rs./1000 coconuts)#	Pollachi (Rs./MT) ##	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 tonne) ##
01.11.2022	13000	22000	20000	28000
05.11.2022	13000	22000	20000	28000
12.11.2022	13000	23000	20000	28000
19.11.2022	13000	24500	20000	26000
26.11.2022	15000	25000	20000	25000
30.11.2022	15000	25000	20000	25000

International price

Coconut

International price and domestic price of coconut oil at different international/ domestic markets are given below.

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
05.11.2022	129	127	176	270
12.11.2022	131	129	175	282
19.11.2022	133	128	176	300
26.11.2022	NR	131	NR	306
				*Pollachi market

Coconut Oil

International price and domestic price of coconut oil at different international/ domestic markets are given below.

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
05.11.2022	1125	1129	NR	1692	1405
12.11.2022	1169	1194	NR	1774	1471
19.11.2022	1174	1218	NR	1706	1438
26.11.2022	NR	NR	NR	NR	1520
					*Kangayam

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
05.11.2022	633	542	928	956
12.11.2022	659	546	936	1017
19.11.2022	656	532	908	1017
26.11.2022	NR	568	NR	1042
				* Kangayam

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

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December 2022
Vol. LXV No.6
Price: Rs.6

Registered No.KL/EKM/721/2021-23
Licence No. KL/CR/EKM/WPP-18/2021-23
Licensed to Post Without Prepayment
RNI No. 3032/1957

INDIAN COCONUT JOURNAL
Date of Publication - 28/12/2022

Printed and Published by Mini Mathew on behalf of Coconut Development Board, Printed at M/s KBPS, Kakkanad, Kochi-30
and Published at Coconut Development Board, Govt. of India,
Ministry of Agriculture and Farmer's Welfare, Kera Bhavan, Kochi-11, Editor: Deepthi Nair S