From the desk of Chairman

Dear coconut farmers,

It is a great privilege and honour for me to take over the additional charge of Chairman, Coconut Development Board, one of the best Commodity Boards serving for the integrated development of coconut cultivation and industry in the country. India is the global leader in coconut production and productivity contributing 31.5% of production with the highest productivity of 10345 nuts/ha. There still exists wide gap in the potential and the present realization. The area under coconut needs to be increased in non-traditional states to meet the increasing demand of coconut processing sector and exports.

In India, coconut is mainly grown as a crop of small and marginal farmers which provides regular income once it commences fruiting. Coconut cultivation has vast potential as a homestead crop in nontraditional states like Bihar, Jharkhand, Chhattisgarh, Assam, Meghalaya, Arunachal Pradesh etc. Cultivation of coconut in nontraditional areas will help in poverty alleviation also. Therefore all our efforts need to be focused on expansion of area under coconut in nontraditional states and increasing the productivity in traditional states by connecting farmers through innovative technologies and its large-scale adoption by the farmers.

Productivity improvement is the main thrust area in the development programmes initiated by Coconut Development Board. The efficacy of scientific management of coconut gardens for productivity improvement of coconut based farming system for enhancing farm level income has been demonstrated by implementing the Laying out of Demonstration Plot (LoDP) programme. CDB is also implementing a massive Replanting and Rejuvenation programme in major coconut growing states like Kerala, Tamil Nadu and Karnataka. The programme aims at cutting and removal of senile and disease advanced palms, rejuvenation of the remaining palms in the garden and replanting wherever necessary for maintaining optimum population of productive palms.

India leads in production and productivity but processes only small portion of it. In the recent years, technology for few novel coconut based products such as Neera and Neera based products, flavored coconut milk, tender coconut ice cream etc. have been developed in the country. Flavored coconut milk is a new product which is having immense potential for re-engineering the coconut sector of the country.

With the introduction of the central sector scheme, Technology Mission on Coconut, 402 coconut processing units have been established in the country with the capacity to process 2419.77 million nuts per year, bringing nearly 11% of the total coconut production of the country into processing sector. Export of coconut sector of Indian economy has also made comprehensive progress over the last decade. Export of coconut products excluding coir products during the year 2015-16 touched a record high value of Rs.14502 million recording an increase of 10.5 % over the previous year. Activated carbon, coconut oil, dry coconut, desiccated coconut, fresh coconut and virgin coconut oil are the major coconut products exported from India. India also imported coconut products valued at Rs. 383.27 crores during 2015-16. Major items of import were copra and oil cake followed by coconut fatty acid, coconut oil and coconut shell charcoal. We are committed to reduce the import of coconut products by policy based promotion of their localized production, value addition and improved marketing.

The efforts of the Board will continue for the benefit of the coconut farming community. Let us collectively work together to make Indian coconut sector more remunerative and rewarding.

With regards

A.K. Singh
Chairman

The future of coconut research

Uron Salum, Executive Director,
Asian and Pacific Coconut Community,
Jakkartha, Indonesia.

Coconut is cultivated in over 90 countries around the world, predominantly in developing countries and the cultivation is more concentrated along the coastal regions. The farms are mostly village based small holder size, mostly under a hectare. Coconut has been used as food in many traditional producing areas from the kernel, water, milk and cooking oil. Crude coconut oil commercially produced from copra continues to be the major commodity traded; however consumption has diversified into desiccated coconut, virgin coconut oil, coconut water, coconut milk, coconut milk powder, coconut flour, coconut sugar and many more related products with additional lines of by-products. Coconut is thus not just an oil crop, but a serious alternative food supplement, a health drink or beverage, a non-dairy alternative and a natural sweetener. Non-edible products include coconut shell charcoal, activated carbon, raw fibre, coir, coir pith, briquettes, coconut timber, handicrafts and major uses in the oleochemical industry including biofuel alternatives.

Research in coconut has been ongoing in the major coconut growing countries for over a century. Central Plantation Crops Research Institute in India is one of the oldest research institutions established in 1916 followed by Coconut Research Institute in Sri Lanka established in 1921 for research in coconut. 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 hybridisation programs in many countries. Search is for varieties for the stresses of climate change effects with the pest and disease emergence. The fast emergence of high value products has also challenged the institutions to provide the best variety for a particular end product. Another area of research and development is for quality assurance of many products of coconut considering the changing consumer demands and stringent food quality standards. Research institutions, universities, scientists and commodity organisations in consuming countries are also involved in coconut research particularly with the nutrition and health benefits.

Genetic resources management and utilisation

Expansion of the genetic base and its characterisation: Severe genetic erosion has occurred in coconut due to rapid urbanisation, industrialisation, deforestation and extensive replanting with improved cultivars. Collection, characterisation, conservation and regeneration of the exotic germplasm is a growing need to meet the challenges of the breeder for long term crop improvement and reducing the vulnerability to various biotic and abiotic factors. This has already been initiated through the establishment of the 5 International Coconut Genebanks by COGENT and the national gene banks established under the initiative of various countries. The accessions in the gene banks not only have a critical role in varietal improvement programs but removing the threat of losing the genetic integrity of local varieties. Research on prebreeding, collection, characterisation, conservation and regeneration of exotic accessions need to be intensified and the potential to prospect for more local varieties need to conserved.

Strengthening or duplication of the International and National Coconut Gene Banks : The threats of climate change and the emergence of lethal diseases capable of wiping out a crop in a region has led to the need for strengthening of the International and National genebanks through duplication of the same or establishing multi-sites as a safety back up. It could be done in the region itself, so that a replica of all the accessions in the ICG is maintained. Establishment of genebanks are not only for conservation but for future utilisation by growers and stakeholders.

Productivity improvement

Mass production of quality seedlings : Increase in percentage of senile palms is a serious issue in coconut

growing countries. A number of countries are in the process of replanting and rejuvenating the coconut gardens. Occurrance of typhoons and cyclones in Philippines and Pacific countries like Fiji and Vanuatu has destroyed large number of coconut palms. The major constraint in replanting is the availability of quality planting materials. Use of mass selection techniques to choose good quality mother palms, seednuts and seedlings of elite local varieties for the replanting programmes should be developed. With increased pressure on land, water and soil nutrients, research should further focus on increasing productivity through development of improved varieties.

Production of hybrids : Coconut breeding and hybridisation programmes to produce Dwarf X Tall or Tall X Tall hybrids for specific purposes like high nut production, high lauric acid, Medium Chain Triglyceride content, tolerance to abiotic stresses like drought, cold temperature, high temperature and salinity should be focussed. Resistance and tolerance to phytoplasma diseases and viral diseases may also be favoured attributes in hybrids.

Management of crop production

Research for Climate Smart Agriculture : Global warming, El Nino and La Nina phenomenon and related changes in the composition of the atmosphere, land and water bodies are found to impact the world in diverse ways. It is noticed that when heavy rains and floods occur in some places, other areas are facing severe drought and high temperatures. Agricultural practices which are environmentally responsible and Climate Smart have to be developed.

As we all know, the reproductive organs of a coconut palm are more sensitive to water stress and high temperature than vegetative parts. The climatic condition during the first three months after inflorescence opening is the most sensitive phase which directly affects fruit set. Heat tolerant and drought tolerant cultivars with respect to reproductive performance should also be developed since it is one of the main adaptation options to minimise effects of climate change.

Coconut based agroforestry systems in coconut lands with annuals and perennials and forage cultivation with livestock raising could be an efficient climate change adaptation and mitigation measure. Coconut is cultivated mostly in the coastal areas in major coconut growing countries and development of a coconut based coastal agroforestry system would be very beneficial especially when typhoons, tsunamis, cyclones and strong winds are experienced more frequently. The Philippine indicate trial planting of three palms in a group was found to resist uprooting during the successive typhoons the country faced during the past three years. Systems for improving the micro climate and CO2 sequestration with coconut based cropping systems and moisture conservation and soil fertility management practices should be developed and promoted to help the small holder coconut farmer adapt to climate change.

Resource management : With increasing pressure on soil, water and nutrients, research on development of technologies for increasing land use efficiency through careful selection of intercrops, water use efficiency, fertiliser use efficiency and increasing productivity of palms should be focussed. Restoration and maintenance of soil fertility also gains prominence since most of the soils are in a degraded state due to improper management, salinity due to frequent sea water inundation in coastal areas and erosion. The package of practices should specify most appropriate combination of crops for managing a profitable farming enterprise with farm economics worked out. The protocols should be environment friendly adhering to sustainable agriculture practices.

Soil and moisture conservation through bioengineering is another area to be addressed and developed. Coconut is usually cultivated in coastal sandy soils which need to be conserved through proper conservation technologies since these soils are poor in organic matter, nutrients and have poor water holding capacity. Research on proper conservation measures through agronomic practices, planting of suitable crops in the interspaces, engineering structures etc should be developed and promoted.

Integrated Pest Management : Research on biocontrol of major pests and diseases including natural predators, pheromones and biopesticides is the need of the hour. The history of coconut cultivation clearly indicates that pests which have been managed and brought to control in one country would later be seen emerging as a major pest in another. Collaborative efforts in developing technology for the management, control and eradication of the pests and diseases is important. The research would have to be continuous since climate change is often seen to encourage emergence of new pests. Holistic pest management techniques should be developed with adequate diagnostic tools for detection of pest and disease incidence and efforts oriented towards bio-based technologies for control. APCC is in the process of establishing an Integrated Pest Management (IPM) Network based on the recommendation of the FAO High Level Expert Consultation on Coconut Sector Development in Asia and the Pacific. It is proposed to have coordinated efforts of specialists in Integrated Pest Management in different coconut growing countries in the functioning of the IPM Network.

Collaborative research on Phytoplasmas : It is alarming to notice that coconut palms are found to be infected by various forms of wilt diseases in various

coconut growing regions. The causal organism is found to be Phytoplasma in case of all the wilt diseases whether it is Root wilt in India or Weligama wilt in Sri Lanka or Lethal Yellowing in Africa and the Caribbean or the recent Bogia Coconut Syndrome in Papua New Guinea. The disease is deadly in some cases, like in Lethal Yellowing, leading to toppling of the crown and death of palm within 3-6 months. In the case of the other forms of wilt, it is found to slowly kill the palms reducing the yield and productivity in the initial stages. It is necessary for a collaborative research on Phytoplasmas to be undertaken by the coconut growing countries to gain control over the disease. Development and refinement of standard diagnostic protocols and approaches and multi location phytoplasma resistance trails utilising the germplasm in the 5 ICGs could be undertaken.

Processing and marketing

Modernisation of Technology for Production : Quality management systems are inevitable for processing units to market their products in today's consumer world. Systems should be in place for ensuring quality of the process and the product. A well developed state of the art technology for processing of coconut products involving efficient production systems with high resource use efficiency and appropriate machinery is crucial. It is also necessary to have a quality management system with appropriate checks at the critical control points and proper documentation of activities with traceability for the buyer which will assure a good market and a premium price for the product. Research on coconut processing in tune to the market needs and demands should be undertaken. For instance, there is market demand for diverse products from coconut oil for oleochemical industry including bio-fuel for which quality process has to be developed. Philippines exports over 36 value added products from coconut. Coconut oil, for instance provides fatty acids, methyl esters, fatty alcohols and glycerine, each of which in turn go in as raw material for a variety of products. Coconut is cultivated by small holder farmers and hence our objective should be to provide the coconut sector with adequate technology which will enable the farmer to maximise his returns. Functional foods from coconut is also an emerging niche market which needs to be researched. Packaging technology needs to be developed not only to contain and make the product attractive, but also to extend the shelf life of the product.

Market research : Coconut is considered a poor man's crop for many generations. Even with increasing demand for coconut products, it does not always convert to increased returns for the farmer. Huge disparities in prices are noticed between countries even for the same product. It is essential to undertake market research on the supply demand situation for the various coconut products, the volumes traded over the years, the growth patterns and the prices realised in the domestic and export markets. Projections on future growth trends would enable the farmer organisation to plan in accordance. Information support to the farmers on prevailing prices, past fluctuations and demand projections would enable them to take better market decisions. Eventually the buyer's market should be transformed to a seller's market. APCC is working towards the development of a trade and market information portal in association with International Trade Centre, a UN/WTO agency to support the coconut farmers with real time accurate information on market prices.

Clinical research

Research on Health and Nutritional Benefits of Coconut Products : Coconut and its products have been consumed in the producing countries from time immemorial. The world is now slowly realising the impact of nutrition and health benefits of coconut that currently drives the global demand for high value products such as virgin coconut oil, coconut water and coconut palm sugar. The consumer world has moved ahead with their choice of coconut products based on anecdotal evidence. Coconut products are believed to have positive impacts on the human health through the anti bacterial, anti viral and anti inflammatory properties of coconut oil. It is believed to be effective against cancer cells, neurological disorders like Alzheimer's, lifestyle disease like diabetes and viral diseases such as HIV/Aids. The cardiological effects from lauric acid and MCTs have already been welcomed by the consumer, but it is necessary to establish conclusive clinical studies that are internationally accepted. APCC has taken the first step forward in this regard. An International Symposium on Quality Coconut Oil for Nutrition and Health was organised during September 2015 in New Delhi, India wherein medical doctors, researchers and clinicians joined together to collaborate on multi country multi ethnic clinical studies on various medicinal attributes of coconut. The APCC Scientific Advisory Committee has been established to take the clinical studies forward with the collaboration of medical institutions in the major coconut growing and consuming countries.

Conclusion

APCC would expect research and development to engage the coconut farmers mid-stream for effective technology transfer. Collaboration between researchers with farmers would enhance the growth and learning objectives of both parties. Technology developed should be to meet the emerging needs and can be adopted and is cost effective. Capacity building programmes should focus training of trainers and recognise the importance of upskilling coconut farmers. ■

Management of coconut garden during rainy season

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South west monsoon has set in and it is time to take up various crop management practices for coconut including planting of coconut seedlings, green manuring, application of first split dose of fertilizers, prophylactic/curative plant protection measures, etc.

Planting of coconut seedlings

In well drained soils, seedlings can be transplanted with the onset of southwest monsoon during June in the west coast region. If the land is uneven and full of shrubs, the shrubs have to be cleared and land levelled before taking pits. In laterite soil with rocky substratum, deeper and wider pits, 1.5 m x 1.5 m x 1.0 m may be dug and filled up with loose soil, powdered cow dung and ash up to a depth of 60 cm before planting. In loamy soils with low water table, planting in pit size of 1 m x 1 m x 1 m filled with top soil to height of 50 cm is generally recommended. However, when the water table is high, planting at the surface or even on mounds may be necessary. 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. In case of laterite soil, addition of 2 kg of common salt will help in loosening the soil.

For realizing better yield from coconut, optimum plant density must be maintained 'in the field. A spacing of 7.5 m x 7.5 m is generally recommended for coconut. This will accommodate 177 palms per ha under the square system of planting. If the triangular system is adopted, an additional 20 to 25 palms can be planted. Hedge system can also be adopted giving a spacing of 5.0 to 5.5 m along the rows and 9 to 10 m between rows.

Generally underplanting is done in coconut gardens where the palms become unproductive and uneconomic

to the farmer. Old palms are removed in stages over a period of 3 to 4 years. First peg mark the area to be underplanted. To start with underplanting, remove the very poor yielders (less than 10 nuts per palm per year) and those trees which are very close to the peg marked point for underplanting. Other trees are to be removed at the rate of one third each year during 2nd, 3rd and 4th year after starting underplanting. If the existing garden is irregularly spaced, remove old palms within 1 m radial distance from the newly planted seedlings in the first year of underplanting, 2 m distance in second year, 3 m distance in third year and the rest in 4th year.

Care of young palms

In areas subjected to water logging, care should be taken to provide drainage facility in the coconut garden during rainy season. The pits should be cleared of weeds periodically. Soil washed down and covering the collar of the seedlings during the rainy days should also be removed.

Green manuring

Cultivation of green manure legumes having symbiotic association with efficient Rhizobium strains in coconut basins and interspaces during the monsoon period is a simple agrotechnique that can be adopted to generate significant quantity of biomass which can be incorporated to the palms at their maximum vegetative growth. If it is homestead type of coconut farming with other inter/mixed crops in the interspace, basin management with green manure legumes can be adopted. Under monocropping, interspace can also be utilised for sowing green manure legumes. At the onset of monsoon, seeds of green manure legumes are to be sown @ 100 g per basin for basin management and the seed rate will be 25 kg per ha of coconut garden if interspace also can be utilised for generating green manure. Green manure leguminous species like cow pea, sunhemp, daincha, horse gram etc are suitable for this purpose. The field experiments on basin management with legumes in adult coconut plantations revealed the effectiveness of this technique to substitute fertilizer nitrogen for coconut upto 30 per cent.

Growing Glyricidia as green manure crop

Substantial quantity of nitrogen rich biomass can be produced through the cultivation of the fast growing perennial leguminous green leaf manure tree crop, Glyricidia in the coconut plantations. This can be very well grown along the borders of coconut plantation and can generate adequate amount of nitrogen rich green leaves. It can also be raised in littoral sandy soils where no other green manure can be established. The tree is propagated either through vegetative cuttings or seeds. One meter long stem cuttings or 3 to 4 month old seedlings raised in poly bags/raised beds can be used for planting. It is preferable that the planting season

coincides with the monsoon (South West / North East monsoon) for better establishment. Spacing of 1 m x 1 m can be adopted. Two rows of glyricidia can be planted along the boundary of coconut garden in a zig zag manner. Plant stem cuttings or seedlings in an upright position in pits of 30 cm3. Height of the plants should always be maintained at 1 m by pruning.

Vermicomposting of coconut leaves

Rainy season is ideal for the production of vermicompost using coconut leaves. Fallen coconut leaves in coconut garden can be effectively converted into rich vermicompost using the earth worm, Eudrilus spp. Vermicompost preparation can be done in cement tanks or in trenches made in the coconut garden. The weathered coconut leaves collected from the garden should be kept for two weeks after sprinkling with cowdung slurry. Cowdung should be used at the rate of one tenth of the weight of the leaves. Afterwards earth worms (Eudrilus sp.) are to be introduced at the rate of one kg for one tonne of the material. Vermicompost will be ready in about 75 to 90 days.

Application of bio fertilizers

Application of phosphate solubilising biofertilizers to coconut palms is highly beneficial when the available phosphorus content in the soil is low. CPCRI has released a product 'Keraprobio' which is a Plant Growth Promoting Rhizobacteria (PGPR) Bacillus megaterium which is also having the phosphate solubilising property. Kera probio can be applied @100 g/palm along with application of organic manures at the fag end of monsoon during August –September.

Fertilizer application

Soil related constraints, especially soil acidity and deficiency/imbalance of nutrients including major, secondary and micronutrients adversely affect coconut production. Hence, it is always advisable to test soil in the coconut garden periodically based on the results of which type and dosage of fertilizers and soil amendments should be decided. From an existing coconut garden soil sample should be taken from the basin of the palm

1 m away from the trunk. Under rainfed situation it is recommended to apply the chemical fertilizers in two splits. In the west coast region, apply one third quantity of recommended fertilizers as the first split after the receipt of summer showers during May and the remaining two-third quantity as second split dose during August-September after the cessation of heavy rains. First split dose ie one third of the recommended dose of fertilizers can be spread around the palms within a radius of 1.8 m in the coconut basin. For correcting soil acidity lime or dolomite can be applied. General recommendation is 1kg lime or dolomite per coconut tree which is to be applied two weeks before the application of chemical fertilizers.

Soil and water conservation measures

Proper soil and moisture conservation practices are essential for ensuring sustainable production especially when coconut is grown under rainfed condition with undulating terrain and sloppy conditions.

Husk burial

Burial of husk in trenches in between the rows of palms is also effective for moisture conservation in coconut gardens. Husk burial is to be done at the beginning of the monsoon in linear trenches of 1.5 to 2 m wide and about 0.3 to 0.5 m deep between rows of palms with concave side of husk facing upwards and each layer is to be covered with soil.

Mulching

Mulching is an important practice for moisture conservation. The coconut basins can be mulched with coir dust, coconut husks, green leaves, dried leaves, organic wastes, and dried coconut leaves. Mulching should be done before the end of north east monsoon and before the top soil dries up.

Catch pit filled with coconut husk

Catch pits can be constructed at all slopes to conserve soil and water. Though there are no standard dimensions for catch pits, catch pits of 1.5 m length x 0.5 m width x 0.5 m depth can be constructed. A bund is to be made at the downside using the excavated soil and pineapple suckers planted on it. This pit is also filled with coconut husk.

Contour trench filled with coconut husk

This measure is to be taken up where the land slope is high. Trenches of 50 cm width x 50 cm depth and convenient length are to be made in between two rows of coconut palms. These trenches would then be filled with coconut husk. Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down. A bund of 20 cm height and suitable width (>50 cm) is made at the downstream using the excavated soil. Two layers of pineapple plants are to be planted on the bund with a spacing of 20 cm x 20 cm. Pineapple plants would stabilize the bund and provide additional income to the farmer. The runoff water from the upper side would be collected in the trenches. Soil particles would also get collected in the trench along with the runoff

water. Coconut husk retains the moisture and makes it available for plants during summer months

Half-moon bund around coconut basin reinforced with pineapple

This measure is to be taken up where there is mild slope (15-20%). Here a flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the downstream side. After making the basin a bund of 30 cm height and >50 cm width is made at the downstream side of the coconut using the excavated soil. Two layers of pineapple plants would be planted with a spacing of 20 cm row to row and 20 cm plant to plant on the bund. 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.

Providing drainage

Proper drainage in the coconut garden is equally important as irrigation for better performance of coconut palms. Waterlogged conditions result in poor growth of palms. In ill drained garden, drainage facilities are to be provided during rainy season by digging deep and wide drains between the rows of palms and by raising the level of the ground around the individual palms.

Planting of perennials as mixed crops

Adoption of multiple cropping practices in coconut garden is suggested to ensure better utilization of basic resources and to enhance income and employment opportunities. After the palms attain a height of 5 to 6 metres (above 18 years) i.e., in older plantations, perennials like cocoa, pepper, cinnamon, clove and nutmeg can be grown as mixed crops. These crops can be planted at the onset of monsoon as per the details given below. These crops are to be adequately and separately manured in addition to the manures applied to the coconut palms. For facilitating multiple cropping in coconut gardens in the early growth phase itself it is advisable to have wider spacing of above 10 m x 10 m so as to provide ample opportunity to accommodate a number of perennial and annual crops in the interspaces.

Cultural requirements of crops for mixed cropping in coconut garden

Crops	Propa-gation	Planting pits	Spacing	No. of plants per ha
Cocoa	Grafts	75 x 75 x 75 cm	3m x 3m (Single hedge)	450
Pepper	Rooted cuttings	50 x 50 x 50 cm	7.5m x 7.5m (At the base of the palm)	175
Clove	Seed-lings	60 x 60 x 60 cm.	7.5m x 7.5m (At the centre of four palms)	148
Nutmeg	Grafts	60 x 60 x 60 cm	7.5m x 7.5m (Cen-tre of four palms)	148

Planting of suitable fodder grass species like Hybrid Bajra Napier (Co3) also can be taken up in coconut gardens at the onset of monsoon as part of coconut based mixed farming.

Field /crop sanitation measures

Decaying organic debris, dead coconut stumps, logs and other such organic materials from the coconut garden are to be removed as a measure of field sanitation to reduce incidence of pest/disease incidence before the monsoon sets in. Similarly, crown cleaning also has to be done before the rainy season.

Crop protection during rainy season

Disease management

Diseases like bud rot and leaf rot affecting coconut are more prevalent during monsoon when the temperature is low and humidity is high. Hence, timely adoption of appropriate prophylactic/curative measures is very important to avoid spread of these diseases during rainy season.

Bud rot

It is important to give prophylactic treatment to all palms in bud rot disease endemic areas at the onset of monsoon. In localities where bud rot is regularly observed crown cleaning of all palms should be taken up and 1% Bordeaux mixture sprayed as a prophylactic measure. Palms should be regularly observed and curative measures have to be adopted as and when the initial symptoms are seen. The earliest symptom is the yellowing of one or two younger leaves surrounding the spindle. The spindle withers and droops down. The tender leaf base and soft tissues of the crown rot into a slimy mass of decayed material emitting a foul smell. The disease kills the palm if not controlled at the early

stages. In early stages of the disease, when the spindle leaf starts withering, cut and remove all affected tissues of the crown and apply Bordeaux paste and protect it from rain by providing a polythene covering till normal shoot emerges. Burn all disease affected tissues removed from the palm. Field sanitation and providing adequate drainage in the coconut garden help to reduce the spread of the disease.

Leaf rot

Leaf rot disease commonly occurs on coconut palms already affected by root (wilt) disease. Infection by this disease is the major reason for the low productivity of root (wilt) affected palms. As a prophylactic treatment against leaf rot disease mix 2 ml Hexaconazole 5 EC in 300 ml water and pour into the well around the base of the spindle leaf or apply talc based formulation of Pseudomonas fluorescens or Bacillus subtilis singly or in consortium @ 50 g in 500 ml/ palm at the onset of monsoon.

As the damage due to rhinoceros beetle infestation increases the chance of bud rot/leaf rot incidence, prophylactic leaf axil filling with 1:1 mixture of neem cake and sand @ 500g / palm before the onset of monsoon (May last week to June first week) is to be taken up on priority basis.

Pest management

For the effective management of pests like rhinoceros beetle, red palm weevil, root grubs and eriophyid mite suitable prophylactic/curative measures are to be adopted in rainy season to avoid crop loss in coconut. Besides, close scrutiny and sustained monitoring in synergy with farm and palm hygiene is the key for success in pest suppression.

Rhinoceros beetle and red palm weevil

For the management of rhinoceros beetle and red palm weevil infestation, prophylactic leaf axil filling with any of the following material before the onset of monsoon (May last week to June first week) is recommended.

• 1: 40 mixture of chloranthraniliprole granule (Fertera 0.4 % WG) and sand @ 250 g / palm (one round/ year during May-June) or

• Leaf axil filling with 1:1 mixture of neem cake or marroti or pongamia and sand @ 500g / palm or

• Leaf axil filling with naphthalene ball @ 12 g / palm and placing sand above it. (Repeat at 45 days interval)

As curative treatment in red palm weevil infested palms, spot application with indoxacarb (Avaunt 15.8 EC) @ 2.5ml / litre or imidacloprid (Confidor 200 SL, 17.8 ai) @ 1 ml/ litre is found effective in suppressing the pest as well as recovery of palms.

Root grubs

For the control of root grub infestation in coconut, blanket application of bifenthrin @ 2 kg ai/ ha (i.e., Talstar 10 EC @ 20 litre / ha) is to be adopted during the last-phase of the South-West monsoon ie., second week of August. Soil application of Steinernema carpocapsae @ 1.5 billion / ha during October is recommended for the bio-suppression of root grubs.

Coconut eriophyid mite

In coconut palms with eriophyid mite incidence, spraying of neemazal (10000 ppm) @ 4 ml/ litre on young buttons after pollination or spraying of palm oil (20 %) sulphur (5%) emulsion during August is recommended.

Conclusion

Timely adoption of crop management practices especially soil health management and prophylactic/ curative plant protection measures is very important to ensure sustainable coconut production. Diseases like bud rot and leaf rot affecting coconut are more prevalent during monsoon. Hence, timely adoption of prophylactic/curative measures is very important to avoid spread of these diseases during rainy season. Similarly, appropriate prophylactic/curative measures are to be adopted in rainy season for the effective management of pests like rhinoceros beetle, red palm weevil, root grubs and eriophyid mite to avoid crop loss in coconut. Adoption of integrated disease management practices by few individual farmers alone can not control the incidence of the fungal disease. Hence, efforts are to be made to facilitate group action among the coconut farmers at grass root level to get desired results for the adoption of IDM practices against bud rot in coconut. Hence, farmer producer organisations like Coconut Producer Societies and Coconut Producer Federations can play important role in organising coconut farmers for effectively adopting prophylactic/curative plant protection measures and other crop management practices during rainy season. ■

Good Agricultural Practices in Coconut Cultivation

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ICAR-CPCRI has introduced QR coded tags for genuineness and authenticity of the planting material which can be decoded by customers after procurement to ensure the variety details and as well as the trust worthiness of the material. In addition, the help desks functioning in these Institutes will provide the farming community about all technical details of the variety and the modus operandi of all farm operations. Since the best planting materials are the crucial component for successful coconut garden, care should be given for the procurement of seedlings from the accredited nurseries in the locality. Being a perennial crop, no compromise should be made on the quality of the seedlings. Varieties released for specific purpose such as tender nut (Chowghat Orange Dwarf), root (wilt) resistant/tolerant (Kalparaksha, Kalpasree and Kalpasankara), ball copra (Lakshadweep micro) etc. should be procured for the notified purpose.

Site of planting

While the ideal soil for coconut is sandy aerated soil, the best site invariably is the one which delivers the highest light to the crop. Light is one of the cardinal principles involved in farming and coconut is no exception to it. To enhance the photosynthetic efficiency of the palm, the seedlings ought to be planted in the open space as far as possible. In most situations in Kerala, coconut seedlings are planted beneath big trees and for want of light, the growth becomes etiolated and such juvenile palms are prone to pest and disease incidence quite rampantly. They also take longer time to come to flowering stage. In addition, seedlings should never be planted in ill-drained soil which in initial phase gets badly affected due to insufficiency in root respiration. Even if it recovers later on, the growth gets stunted and the palm yield will be adversely affected. Juvenile palms need sufficient moisture but at the same time could not withstand water logging. Good light and well aerated soil are the pre-requisites for the establishment of coconut palm.

Adequate crop geometry

As a thumb rule, one cent (40 m^2) can accommodate only one coconut seedling. When coconut is raised as a monocrop, for tall cultivars, spacing of 7.5 m x 7.5 m and for dwarf cultivars 7.0 m x 7.0 m spacing is recommended. In the case of existing homestead condition, number of palms could be further reduced to accommodate the growing trees without compromising on light. Planting seedlings with reduced spacing would induce odour cues in favour of pest orientation enhancing palm susceptibility to pest attack. However, intercropping of palms with nutmeg, rambutan, curry leaf, banana along the interspaces disorients the pest

away from the source due to crop-habitat diversification induced pest-repulsion cues. Crop heterogeneity is, therefore, preferred for continuous employment of farmers, income generation as well as pest regression. Installation of bird perch and flowering plants like coral vines maintains pest defenders and executes ecosystem services. Damage by rhinoceros beetle is reported to be reduced in coconut based cropping garden than in mono-cropped garden. This technology is well displayed at ICAR-CPCRI, Regional Station, Kayamkulam.

Sustainable crop care

Bio-priming of seedlings with Pseudomonas fluorescens @ 50 g (108 cfu/g) during four, seven, and ten months after sowing in the nursery is recommended. At the time of planting, dip the seedling in 100 g (108 cfu/g) of talc-based preparation of P. fluorescens in slurry mode. Maintaining glyricidia along the borders and using the cut leaves as mulch in the basin not only conserves the soil microbes, but also add organic carbon in to the soil. A good organic base in the soil is very important for the improvement of physical, chemical and biological properties of soil as well as for enhanced availability of nutrients. Organic manuring enhances the beneficial microbial load in the soil and favours better availability of other nutrients and bio-enzymes for palm growth. With heavy rainfall experienced in most of the coconut-growing regions, sizeable quantities of the essential nutrients are leached off in the absence of good organic matter. Application of well-decomposed vermicompost (10 kg/palm) or farm yard manure (25 kg/palm), neem cake (2 kg/palm) fortified with Trichoderma harzianum (250 g/palm) is also recommended for improving the health of the juvenile palm in the initial phase of establishment.

In situ biomass recycling

Raising leguminous green manure crops such as Peuraria phaseoloides / Vigna unguiculata (cow pea) / Crotalaria juncea (sun hemp) @ 100 g in palm basins during April-May and September-October not only fixes atmospheric nitrogen but also enhances the C:N ratio for better growth. Up root the plants and incorporate the biomass when one or two plants start flowering. Green manure incorporated soil will be well aerated aiding better root growth and withstands moisture stress.

Soil and water conservation measures

In order to conserve soil moisture during summer months (November-May), mulching the basins with coconut leaves / burying coconut husks with the cessation of north east monsoon is very important. This will also prevent erosion of fertile top soil during monsoon. Irrigation is very critical for the growth of palms. Application of 250 litres of water/palm / week is very much essential during summer period to mitigate the moisture stress. Drip irrigation in tune with "per drop more crop" is another strategy in optimum water utilization for attaining the highest productivity. A proper drainage is also advised during rainy season. In coastal areas where inundation of sea water is possible inciting diseases, application of 500 g T. harzianum enriched neem cake and incorporation of green leaf manures are recommended.

Buffering pH and nutrient delivery

Soils need to be ameliorated for better nutrient utilization in the system. Due to acidic nature of soils in Kerala, one kg dolomite is recommended per palm per year. In addition to pH buffering, dolomite delivers calcium and magnesium required for palm growth. For the continuous growth as well as regular flowering, a sustained flow of nutrients is required irrespective of seasons. Soil-test based application of NPK fertilizers (the general recommended dose being 500 g N, 300 g P2O5, 1250 g, K2O and 250g MgSO4/palm /year) in two splits during May-June and August-September is recommended. Juvenile palms should be provided with 1/10, 1/3, 2/3 dose of NPK during the first three years of planting in the main field. Judicious application of micronutrients based on soil analysis and for adult palms, application of borax @ 120 g in four split doses based on the intensity of deficiency symptom is also recommended.

Inclusive farming with coconut

System approach such as cropping system with different crops harnessing maximum resources in a compatible manner as well as integrated farming system with inclusion of dairy, goat, bee keeping etc. ensures complete employment and continuous income to farm family. Coconut based high-density multi species cropping (HDMSCS) is a classical example. Adopt cropping system approach by raising compatible intercrops in rotation/adopt mixed cropping/mixed farming with recycling of organic matter for reaping sustainable income. Restructuring of canopy of other

perennial tree crops to provide maximum light for the coconut palms is recommended.

Bio-intensive pest and disease management

Eco-friendly and biological-system based technologies have been evolved for the successful management of key pests and diseases of coconut palm. Rhinoceros beetle is suppressed by leaf axil filling of botanical cakes (Neem/marotti/pongamia @250 g with sand), mechanical hooking of beetles, treating breeding sites with Metarhizium anisopliae (5 x 1011/ m3) or the weed, Clerodendron infortunatum and release of Oryctes rhinoceros nudi-virosed beetles (12 beetles/ha). Red palm weevil is suppressed by farm and palm hygiene, systematic and sustained monitoring, trapping beetles using pheromone traps and curative management with chemicals (Imidacloprid 0.02%/ Indoxacarb 0.04%). For the suppression of eriophyid mite, an integrated strategy with need-based application of botanicals (Azadirachtin 10000 ppm @0.004%) either by spraying or root-feeding, spraying of talc-based preparations of Hirsutella thompsonii (20 g/palm) and adequate nutrient management of affected palms were found effective. Release of stage-specific parasitoids (Goniozus nephantidis 20 / palm) was found to be the most effective tool in the bio-suppression of coconut leaf eating caterpillar.

Planting resistant coconut varieties to root (wilt) disease (Kalparaksha, Kalpasree) and a tolerant hybrid (Kalpasankara) is a very effective option in the management of root (wilt) disease of coconut. Systematic nutrient application as well as management of leaf rot disease through talc-based preparations of P. fluorescens / Bacillus subtilis or consortia of the two bioagents (50 g in 500 ml water/palm) suppress the disease when applied during April-May and October-November. Management of bud rot disease involves removal of disease affected palms, field and palm hygiene, 1% Bordeaux mixture application and control of rhinoceros beetle damage. Stem bleeding is subdued by swabbing the affected portion with the paste of talc-based Trichoderma preparations along with application of neem cake enriched with Trichoderma (5 kg / palm) during post-monsoon period.

Strengthen quarantine so that the potential invasives such as coconut leaf beetle, Brontispa longissima, scale insect, Aspidiotus rigidus, red ring disease, lethal yellowing and foliar decay virus are not entering our country. Domestic quarantine is envisaged for root (wilt) disease of coconut, leaf beetle, Wallacea sp. from entering different coconut zones of the country. Awareness campaign, sensitization literature and emergency preparedness module to tackle such invasions are streamlined.

Technology delivery through community approach

Success of a technology in yield maximization and (or) pest suppression is accomplished only under farmer-participatory community mode. Technology reach out was quite successful in this approach with significant gain in technical know-how by farmers as conducted in studies by ICAR-CPCRI. Farmer Field School (FFS) is another success tool in technology delivery. It is therefore very crucial to disseminate a new technology in farmer-participatory community-mode or effective societal outreach. Mera Gaon Mera Gaurav is another flagship programme disseminating knowledge at farmer's doorstep by farm scientists.

Farmers adopting the aforesaid ten thronged charter of activities pertaining to coconut "from womb to tomb" could realize the outcome of GAP intended for ecological sustainability, environmental stability and accomplishing on-farm food safety and security standards. Let us follow it up scrupulously for enhanced success in coconut farming. ■

Quality planting material- a crucial input in cocoa farming

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Cultivation of cocoa is gaining momentum in India and is presently cultivated in an area of 80,180 ha. Of these 28,209 ha is in Tamilnadu followed by 24,156 ha in Kerala. The country is importing about 60 % of the demand for cocoa and the demand in the domestic market is increasing in the country by 15 % annually. The country produces 17,200 MT of cocoa annually, with an average productivity of 550 kg per ha. Cocoa is cultivated in four southern states namely Kerala, Andhra Pradesh, Tamil Nadu and Karnataka, mainly as an inter crop in coconut and arecanut gardens. Cocoa is also an export oriented commodity and India exported cocoa bean and cocoa products valued Rs. 1118 crores during the last year 2015-16.

Cocoa is a profitable mixed crop in coconut garden. Due to the wide gap in demand and supply of cocoa beans in the world, farmers are now getting a remunerative price for cocoa. Realizing the potential to introduce this crop as intercrop in coconut garden, farmers show interest cultivating cocoa as a mixed crop in coconut garden. One of the constraints faced by the farmers in cocoa planting is the non availability of good planting materials. As in the case of any other crop good quality planting material which is a crucial input for realizing high yield and good quality cocoa.

The cocoa can be propagated through seeds and vegetative means through grafting. On account of the right plant architecture, easy management, low cost and high degree of resistance to stress, seed propagation is preferred. The high genetic variability among the hybrid seedling progeny is generally acceptable as it is proved that the total yield from the unit area of hybrid cocoa plantation is on par with that of a clonal garden. Hence hybrid seedlings produced from seeds collected from bi-clonal or polyclonal seed gardens involving self incompatible pre potent parent are recommended as planting material for cocoa cultivation.

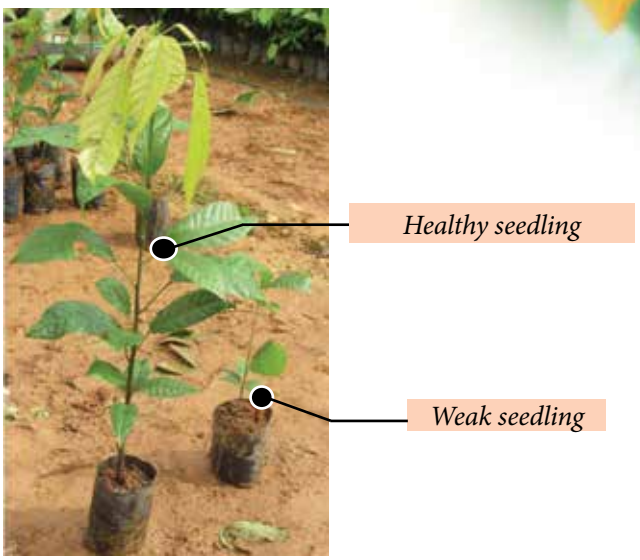
The general quality parameters recommended for seeds and seedlings are given below. While selecting cocoa beans for seed purpose fresh beans should be used for sowing as cocoa seeds loose their viability faster. The seed should be rubbed with sand or ash to remove the mucilage before planting and sown with their pointed end upwards in the polythene bag in the nursery. The size off the polythene bag used should be 25x15 cm with 150 gauge thickness. Seedlings will be ready for planting after 3-4 months.

Planting cocoa in coconut gardens

In a coconut garden planted at 7.5m x 7.5m, spacing with an age of above ten years, cocoa can be planted at a spacing of 3m between plants in a single row system in the middle of two rows of coconut palms. Besides in between each coconut plant in a row, one cocoa plant can also be planted. Thus about 500 cocoa plants can be accommodated in a hectare of coconut garden. Six month old forestero variety hybrid seedlings recommended variety are generally advised for planting. The best season for planting is during monsoon season (June-July) but in places where irrigation facilities are available, planting can be done throughout the year. Pits of size 50cmx50cmx50cm should be prepared for

Quality standards - Cocoa seeds	
Characters	Standards
Pod size and weight	Medium or large pods of not less than 350g.
Husk thickness	More than 1 cm.
Pod value(No. of pods required to produce 1 kg. wet beans)	Not more than 12
No. of beans per pod	Not less than 35.
Bean dry weight	Not less than 1g.

Quality standards - Cocoa hybrid seedlings	
Characters	Standards
Age of the seedling	5-6 months
Number of leaves	5-6 pairs
Height of the graft	45-50 cm
Growth	Vigorous seedlings growing straight at the middle of the poly-bag.
Jorquetting	No jorquetting



planting at the onset of monsoon. The pits should be filled up with mixture of top soil, compost or farm yard and manure just before planting and a small planting hole should be made at the centre of the pit. The planting hole should be of the same size as to hold the basket or polythene bag in which seedlings are raised. While planting, care should be taken to plant the seedlings on the soil surface rather than in deep pits.

Care and management of cocoa plants in coconut garden

Application of organic manure will be useful in the early establishment period. It may not be necessary after about three to five years as cocoa litter will be a rich source of organic matter. An annual application of 100g N, (216g urea)40g P2O5 (195g rock phosphate)and 140g K2o(228gMuriate of potash) per plant per year in two equal split doses is recommended. During the first year of planting, the plants may be given 1/3rd of the above dose, while during the second and third year 2/3rd and full dose of fertilizers are applied. While applying manures and fertilizers, care should be taken to open only shallow basins around the plants (radius of 1.5m for adult cocoa) and to avoid serious damage to the surface feeding root systems. The radius of the basins should be proportionately smaller for young cocoa. Providing adequate irrigation helps in increasing the yield by about 30 % both in mono as well as in inter croping system. Irrigation could beneficially be given once in a week in dry months.

Pruning is an important continuous operation in cocoa. Cocoa grows in a series of stories. The chupon or vertical branch of the seedlings terminates at the jorquette when four or five branches develop. Further chupon develops just below the jorquette and continues its vertical growth till another jorquette develops and so on. When the first jorquette develops at a height of 1.5m, the canopy will form at a height convenient for harvesting and other operations. It is desirable to limit the tree at that level by periodical removal of chupon growth when it is planted as inter crop in coconut garden. Operations like harvesting, spraying etc. will be easier if the height of the trees is kept at the first story level. Generally three to five branches develop at each jorquette.

When more fan branches develop one or two weaker ones have to be removed. Similarly overlapping branches also have to be removed for facilitating uniform light penetration at every part of canopy. In coconut gardens, where cocoa is planted as stated above, the climate and soil, allow a continuous growth. Cocoa trees and

will form a jorquette within 6-9 months of planting, the canopies will meet at a spacing of 3 x 3m within 18 months and the 1st crop may be obtained towards the end of 2nd year or in 3rd year.

The success of a plantation depends upon the quality of planting material used. Unfortunately, in some States, the success percentage of establishment of hybrid seedlings in the main field is low. This is due to non adherence to the use of quality planting materials. Non availability of planting material at the vicinity of the farmers in the right time is one of the main constrains in cocoa area expansion programme. Hence, the Directorate of Cashewnut and Cocoa Development has taken initiatives to develop and accredit cocoa nurseries for the production and distribution of good quality planting materials which is most important component for the establishment of cocoa plantations in our country. The Directorate has accredited 14 cocoa nurseries for the production and distribution of good quality cocoa hybrid seedlings. These cocoa nurseries have a production capacity of 35 lakhs cocoa hybrid seedlings.

The production of quality planting material can only be achieved through a regulated network of nurseries set up for production of certified planting material. Up gradation of existing nurseries to meet the accreditation requirement for enhancing their production potential also is being taken up by Directorate of Cashew and Cocoa Development (DCCD) with financial assistance under MIDH. The accredited nurseries will be under the monitoring of DCCD, National Accreditation Authority approved by the Ministry of Agriculture, Government of India. The nurseries will have to undergo an accreditation process involving application to the Authority for approval based on certain essential and desirable criteria and granting of Accreditation based inspection by the Directorate. Details of guidelines, and application for accreditation nurseries is available in the website of DCCD. ■

Coconut milk:

a healthy energy drink from your courtyard

● **Aswini Abraham,** Consultant, CDB, Kochi - 11

Once again the coconut tree proves the Vedas right for calling it 'Kalpavruksha', the tree of life. Nature extends its motherly arms to us through this plant with diverse uses, besides setting skylimits for earning a livelihood.

Coconut milk- a healthy drink for all age groups

Coconut milk is a product obtained by extracting the juice of coconut meat. It is rich in healthy saturated fat and energy. Coconut milk contains about 17-24% fat, depending on the amount of water used in processing. With a creamy texture and slight natural sweetness, coconut milk is often considered a "miracle liquid" since it offers the nutrition to build up the body's immune system and prevent diseases.

The health benefits of coconut and coconut milk are just beginning to be understood. Although coconut contains saturated fat, a closer examination shows that not all saturated fats pose health problem. Saturated fat chains exist in a variety of lengths which impact the body differently. Fat is made up of chains of fatty acids. These fatty acids are important source of fuel for our body, because when metabolized, it yields energy. The vast majority of fat in our diet, whether saturated or unsaturated or from plant or animal, are composed of long chain fatty acids (LCFAs). Soyabean oil, corn oil, olive oil, lard, chicken fats as well as most other fats and oils in our diet are composed entirely of LCFAs. LCFAs cannot cross the blood–brain barrier and so cannot be used as fuel by the cells of the central nervous system; but medium-chain fatty acids can be used.

The fat present in coconut and coconut milk are made of medium chain fatty acids (MCFA). Since MCFA molecules present in coconut milk are smaller when compared to LCFAs, it requires less effort to be broken down. The MCFAs are broken down almost immediately by enzymes in the saliva and gastric juices for which digestive enzymes are not even essential. It is then quickly absorbed by the cells and converted into energy giving liveliness to the body immediately. Nature's richest dietary source of medium chain fatty acids are coconut oil (64%) and palm kernel oil (58%).

As MCFAs are immediately broken down and absorbed by the cells, it do not circulate in the bloodstream to the degree that other fats do. Consequently it does not get packed inside fat cells or clog artery walls. It is used to produce energy, not body fat or arterial plaque. This makes coconut milk juice an ideal health drink for people suffering from digestive and metabolic problems, diabetes, obesity, gall bladder diseases, pancreatitis, crohn's diseases and pancreatic insufficiency. Hence, this is a healthy drink for all age groups.

Coconut milk- comparable to mother's milk

One of the remarkable characteristics of medium chain fatty acids in coconut milk is its ability to kill germs and parasites. 48% of coconut oil present in coconut milk contains a fatty acid called 'lauric acid', which is present in mother's milk. As per the studies of Dr. Mary G.Enig, Director, Nutritional Sciences Division, Enig Associates Inc, USA, our body uses the lauric acid in coconut oil to make the same disease fighting agent called monolaurin that babies make from the lauric acid they get from mother's milk. In fact, monolaurin is the primary ingredient in mother's milk that protects infants from infections for the first few months of their lives while their immune system is still developing.

New born babies do not have digestive enzymes to process food. An enzyme called lipase present in the saliva helps in their digestion. Only mother's milk and coconut milk can be digested in this manner in new born babies. For this reason coconut milk is routinely added to baby formulas.

The nutritional comparison between breast milk and the coconut milk baby formula is given below:		
Nutrition Facts	** Breast Milk (36 oz)	Coconut Milk Formula (36oz)
Protein	766g	11g
Carbohydrates	76g	60g
Total Fat	48g	53g
Saturated Fat	22g	41g
Mono Fat	18g	6.6g
Poly Fat	5.5g	1.4g
Omega - 3 FA	0.58g	0.932g
Omega - 6 FA	4.4g	0.831g
Cholesterol	153mg	55.8mg
Vitamin A	946IU	4850IU
Thiamin - B1	0.51mg	0.7mg
Riboflavin - B2	0.4mg	0.7mg
Niacin - B3	1.9mg	4.6mg
Vitamin B6	0.12mg	0.8mg
Vitamin B12	0.5mcg	66.6mcg
Folate	57mcg	65.1mcg
Vitamin C	55mg	2.7mg
Vitamin D	480IU	450IU
Vitamin E	9.9mg	0.5mg
Calcium	355mg	112mg
Copper	0.57mg	0.4mg
Iron	0.33mg	6.1mg
Magnesium	37.4mg	72.5mg
Manganese	0.29mg	1.4mg
Phosphorus	151mg	167mg
Potassium	560mg	397mg
Selenium	18.8mcg	5.4mcg
Sodium	186mg	35.5mg
Zinc	1.9mg	1.2mg
Calories	766	723
*Source: Draxe.com, ** Breast milk cannot be substituted by Coconut milk.*		

A dairy free milk

For people who don't or can't use dairy products, coconut milk is a healthy alternative. Many people are lactose intolerant or allergic to dairy. Some don't consume dairy products because they prefer to be vegans.

Food allergies are a major problem with many people. Over 60% of all food allergies are due to animal based milk and nuts. The good news for these people is that they have an alternative with coconut milk. Based on medical research and clinical observation, coconut is considered a hypoallergenic food and therefore is recommended as a nutritious substitute in the diet of those who are troubled by allergies. Because coconut milk is completely free from dairy, lactose, soy, nut or grains, it's a good option for anyone who is allergic to dairy and nut or grain based milks. It's the best food for vegans.

Coconut milk for lactose intolerant

25% of the world population is found to be intolerant to lactose. Lactose is the sugar present in the milk of mammals. An enzyme called lactase is produced inside the small intestine of mammals, which breaks down the lactose into glucose and galactose so that it can be absorbed into body. The deficiency of lactase in body makes one lactose intolerant. Lactase deficiency can also happen due to aging. Coconut milk, which is free of lactose, is a good remedy for these people. Besides developing the immune system, the calcium and phosphorous present in coconut milk decreases the chances of osteoporosis, which is likely to occur in elderly people who are lactose intolerant.

Yummy Banana-Coconut Milk Shake:

Ingredients:

1. 1/2 cup Coconut Milk
2. 1/2 cup Vanilla Ice Cream
3. 1 medium Banana
4. 1/2 tablespoon Sugar
5. 2 Ice cubes

Directions:

1. Peel the banana and cut into small pieces.
2. Pour coconut milk in a blender jar. You can use either canned or homemade or tetra pack coconut milk according to the availability.
3. Add banana, vanilla ice cream, ice cubes and sugar.
4. Blend until all ingredients are well mixed and like puree. Check the consistency of milk shake, if it is not to your liking, add coconut water or coconut milk to reduce thickness or add more bananas to thicken it.

Coconut Milk Shake is ready. Serve it chilled.

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Scientific management of young coconut palms

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Coconut (*Cocos nucifera,* L.) is one of the most useful palms known to mankind. It provides nutritious food and refreshing drink, edible oil and non-edible uses, fiber of commercial value, shells for fuel and industrial uses, timber and a variety of miscellaneous products for domestic and industrial uses. It is grown mainly in coastal areas and island ecosystems sustaining the livelihood of people and protecting the environment.

Quality planting material is one of the important component for enhancing the production and productivity of any crop. It has more relevance in a perennial crop like coconut with a gestation period of four to six years and a bearing period of more than 60 years. The care during initial years of planting in the main field is also very crucial for successful cultivation. Farmer usually takes keen interest in procuring the best coconut seedling. But there is little effort from farmer's side in scientific management of young coconut palms. Hence, this article focuses on the scientific management practices to be adopted for deriving the maximum productivity from the material planted.

Selection of good quality seedlings

One year old quality coconut seedlings will have a minimum of six leaves with a short petiole, dark green and broad leaves and large number of roots. They will have a collar girth of 10 cm and above. Seedling which shows early splitting of leaves may be preferred for planting.

Seedling should be removed from the nursery using spade / crow bar and should never be lifted from soil by pulling the leaves or petiole. The seedling should be planted as early as possible after removal from the nursery. The seedlings can be stored for a period of one week. In such cases, the seedlings should be kept under shade and also watered.

Land preparation

Well drained sandy loam soil is best suited for coconut cultivation. The land should be open without any trees so as to provide maximum sunlight to the growing palms. If the land is uneven and full of shrubs, the shrubs be

Table. 1. Fertilizer recommendation of young coconut palms (g/tree)

Year of planting	May - June			September- October		
	Urea	Musso-riephos	MOP	Urea	Musso-riephos	MOP
First year	Planting in May- June			110	150	170
Second year	120	170	190	240	340	375
Third year	240	340	380	480	680	750
Fourth year onwards	365	500	560	730	1000	1125

Field planting of coconut seedling

Shading using plated coconut leaves

Leaf axil placement of ferterra sachet

Manuring of young palm

Twisted growing point due to rhinoceros beetle attack

cleared and leveled before taking pits. Adequate supply of water either through well distributed rainfall or irrigation should be ensured. In sloppy areas, soil and water conservation measures are to be adopted. In low lying water logged areas, planting is done on raised mounds. In laterite soil, addition of 2 kg common salt 6 months prior to planting will help in loosening the soil.

Spacing

An optimum plant density must be maintained in the field so as to ensure better yield from coconut and also for effective utilization of naturals resources viz., sun light, soil and nutrients. A spacing of 7.5 m x 7.5 m is generally recommended for tall coconut varieties so as to accommodate 175 palms/hectare. Dwarf varieties may be planted at a spacing of 7.0 m X 7.0 m.

Time of planting

In well drained soils where water stagnation is not a problem, seedling can be transplanted with the onset of South-West monsoon (May-June). If irrigation facilities are available, it is advisable to take up planting at least one month before the monsoon sets in so that the seedlings get established before the onset of heavy rains. In low lying areas, where water logging is a problem during monsoon period, it is advisable to plant the seedlings after cessation of monsoon.

The depth of pits will depend upon the type of soil. In laterite soils deeper and wide pits of 1.2 x 1.2 x1.2 m, may be dug and in sandy loam soils, pits of size of 1 x1 x 1 m is sufficient. The pit is filled with top soil, powdered cow dung, and ash upto a height of 60 cm and a small pit is dug at the centre for planting the seedling. After planting, press the soil well around the seedling.

Biopriming

Bio-priming of seedlings with bio-inoculants such as *Pseudomonas fluorescens* imparts tolerance to disease as well as promotes better seedling growth. Initial establishment of such seedlings was found to be superior in the main field with enhanced vigour and field tolerance to diseases. At the time of planting in the main field, dip the coconut seedlings in 100 g (108 cfu/g) of talc-based preparation of *P. fluorescens* in slurry-mode.

Care of young palms

The field planted seedlings should be shaded and irrigated during summer months. Irrigation with 45 litres of water once in 4 days has been found to be satisfactory for all soil types. Provision of proper drainage should be ensured in low lying areas prone to water logging. Weeding should be done periodically as weeds compete for water and nutrients, thereby affecting the growth of the palms. Soils washed down by the rains and covering collar region of young seedlings should be removed. The pits should be widened every year before the application of organic/inorganic fertilizers. The pits should be gradually filled up by cutting the soils from side as the seedlings grow. The palms should be frequently monitored for any pests or disease incidence and necessary remedial measures should be taken up promptly.

Manuring

Regular manuring right from the first year of planting is essential for good vegetative growth, early flowering and high yield of coconut palms. The first application of fertilizer should be done three months after planting. During the initial year, the quantity of chemical fertilizer to be applied is one tenth of recommended dose of fertilizer for adult palm. During the second year, one third of the dose 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 fourth year onwards, fertilizer may be applied at the rate recommended for adult palms. The fertilizer schedule for young palms is given table.1. Along with second split dose during September – October, 3-10 kg organic manures such as vermicompost or neem cake (first year- 3kg, second year- 5kg, third year onwards-10kg) may be spread in the pits and after applying the fertilizers, covered with soil.

Pests and diseases

Rhinoceros beetle infestation is commonly seen in young coconut palms and is more predominant in dwarf varieties compared to talls. Adult beetle bores into the collar region of coconut seedlings and brings forth dead heart-like symptoms. Central core of the spindle is severely affected and irrecoverable loss is induced. Extrusion of chewed up fibre at the bore hole is one of the characteristic symptoms of identification. In many cases, the growing point gets twisted, malformed and remarkable loss in vigour is observed. Presence of geometric V-shaped cuts on leaflets is quite common in juvenile palms. As a prophylactic measure, the inner most leaf axils may be filled with neem cake or marotti cake @250g/ palm mixed with equal quantity of sand. Placement of two naphthalene balls (8g) in the leaf axils and covering with sand at 45 days interval is also effective. Alternatively placement of small perforated sachet containing 4-5 g Ferterra/Fipronil in the inner most leaf axils may be attempted. Bud rot and leaf rot are the major diseases noticed in young palms. Spraying 1% Bordeaux mixture in the inner most leaf axils is effective in managing the fungal diseases.

It has been noticed that the dwarf varieties come to bearing within three years of planting and tall varieties in five years if proper management is given during initial years. As the yield of coconut palms in future is influenced by management given in the initial stage, the farmers should pay more attention for scientific management of young palms along with selection of best planting materials. ■

Mother of all oils - Virgin coconut oil

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Coconut is one of the most important crops grown in the humid tropics. Coconut is a wonder fruit which provides the consumer both with a refreshing drink from its water and energy from its kernel. India is the largest coconut producing country with around 1.98 million hectares under the crop. Annual production of coconut in India is about 20439.61 million nuts with a productivity of 10345 nuts per ha. In India, the four south Indian states namely Kerala, Tamil Nadu, Karnataka and Andhra Pradesh account for around 90.11 % of the coconut production in the country. In India, Tamil Nadu is having the highest yield among the major coconut producing states with 14837 nuts followed by Andhra Pradesh with 13808 nuts.

Coconut oil is one of the most widely used products made from coconut. It is consumed in tropical countries for many centuries. Coconut oil carries a long shelf life and is capitalized in baking industries, processed foods, infant formulae, pharmaceuticals, cosmetics etc. Copra oil, Refined, Bleached and Deodorized (RBD) coconut oil and Virgin coconut oil (VCO) are the three types of coconut oil. The main difference between these oil are in the way they are processed.

Types of coconut oil

Traditionally copra oil is produced by crushing copra, the dried mature coconut kernel, which contains about 60 - 65% of the oil. The traditionally produced oil may undergo chemical refining, bleaching and deodorization processes. Refined, Bleached and Deodorized (RBD) coconut oil made from copra is yellow in colour, odourless, tasteless and does not contain natural Vitamin E, since this is removed when the oil is subjected to high temperature and various chemical processes.

Virgin coconut oil is obtained from the fresh, mature kernel (meat) of coconut by mechanical or natural means, with or without the use of heat, without undergoing chemical refining, bleaching or deodourising and which does not lead to the alteration of the nature of oil. Virgin coconut oil is suitable for human consumption without further processing.

Virgin coconut oil mainly consists of medium chain triglycerides, which are resistant to peroxidation. The saturated fatty acids in virgin coconut oil are distinct from animal fats, as the latter consisting mainly of long chain saturated fatty acids.

Virgin coconut oil is the purest form of coconut oil. It contains natural Vitamin E and has not undergone any hydrolytic and atmospheric oxidation as demonstrated by its very low, free fatty acid (FFA) content (even without refining) and low peroxide value. It has a fresh coconut aroma that can be mild to intense depending on the oil extraction process used.

Properties of virgin coconut oil

Physical properties

Colour: Virgin coconut oil is colourless. Based on the studies done under the Philippines / UK Aflatoxin Reduction in Copra Project, the colour of the oil is either brought about by contaminants in the oil, or by high temperature processing and microbial contamination of the coconut meat prior to oil extraction. Depending on the type of microorganisms that cause the contamination, the oil colour can be yellow or pink or red orange.

Aroma: It has a sweet coconut aroma which may range from mild to intense depending on the process used for extraction. A good quality VCO does not have any rancid smell.

Taste: VCO has a nutty flavor. Good quality VCO should not have off-flavours or a sour taste. It should not cause any itchiness in the throat when ingested as this is an indication that the free fatty acid content is already higher than the prescribed standard.

Nutritional properties

Coconut has a rich abundance of medium chain fatty acids, which are rapidly absorbed in the intestine, thus not allowing for their participation in cholestrol transport and providing quick source of energy. The medium chain fatty acids are an integral component of an energy source or those recovering from chronic illnesses and for infants.

Virgin coconut oil has a rich content of medium chain fatty acids, consisting of caproic acid, caprylic acid and lauric acid. Apart from the high concentration of medium chain fatty acids (59.02% to 62.27%), virgin coconut oil also contains mono and di unsaturated fatty acids. These concentration of saturated fatty acids and total unsaturated fatty acids range from 28% to 31% and 6.73 % to 8.13%, respectively. It is rich in polyphenols and medium chain fatty acids especially lauric acid (47.8% of total fat) which makes it similar to the mother's milk (lauric acid : 6.2% of total fat) and hence described as "the mother of all oils."

Virgin coconut oil is having a high total phenolic content (11.82 -29.18 mg gallic acid equivalents [GAE]/100g oil), which is responsible for its high antioxidant properties (antioxidant activity ranging from 53.54% to 79.87%). The phenolic content was found to be high in virgin coconut oil, which is capable of reducing the lipid peroxidation. The high phenolic content is also responsible for normalising lipids through various pathways. It is these properties of virgin coconut oil that make it a potential healthy addition to the normal diet.

Methods of extraction

There are different methods for extracting virgin coconut oil. It can be extracted from coconut meat, coconut milk and coconut milk residue.

Methods using coconut meat as raw material

Direct micro expeller method

Direct micro expeller (DME) method or low pressure extraction method is one of the most widely practised methods. DME system involves four basic steps.

- Collection and dehusking of coconuts
- Finely grating the fresh mature coconut kernel
- Drying the grated coconut to specific moisture content in an innovative solar- thermal dryer which uses the fuel as the discarded coconut husks and shells.
- Pressing out in hand operated press to obtain the virgin coconut oil
- The byproduct obtained is coconut meat residue which is used as culinary or in animal feeds.

Wet extraction

Wet processing or aqueous processing is the term used for extraction of coconut oil directly from coconut milk. This method eliminates the use of solvent which reportedly may lower the investment cost and energy requirements. Furthermore, it eliminates the RBD process. Even though the concept appears potentially attractive, however, the method yields comparatively low content of oil, which has discouraged its commercial application. The wet processing can only be carried out by means of coconut milk by breaking the emulsion. This is rather difficult due to the high stability emulsion of coconut milk. Destabilization can be done through three mechanisms. The first stage is creaming by the action of gravitational force resulting in two phases, with the higher specific gravity takes place at the top phase and the lower specific gravity phase moves downward. The second stage is flocculation or clustering in which the oil phase moves as a group which does not involve the rupture of the interfacial film that normally surrounds each globule and therefore does not change the original globule. The last stage, coalescence is the most critical phase in destabilization. During this stage, the interfacial area is ruptured; the globules joined together and reduced the interfacial area. The wet process appears more desirable due to the free usage of chemical solvents, thus more environmental friendly than solvent extraction.

Table 1: Different methods of VCO extraction using coconut meat.

Type of process	Quality of oil and recovery	Advantages and limitations
1. Fresh dry process (wet milling route) (high pressure expeller method) M.C of meat for extraction should be 3-4%	FFA : 0.05-0.08% M.C: 0.07-0.1% Colour: water like Oil recovery: 31kg/100kg of fresh milled coconut meat (Based on 50% initial M.C of fresh meat.)	Produces full protein, medium fat coconut flour as a co-product. Long shelf-life of oil: 1 yr and more. Uses mechanical type of equipment to produce the oil. Can be produced in a village-scale plant operation.
2. Fresh dry process (grated coconut route) (high pressure expeller method) M.C of meat for extraction should be 3-4%	FFA : 0.05- 0.08% M.C: 0.07 – 0.1% and above Colour: water like Oil recovery:24.5kg/100kg of fresh milled coconut meat (Based on 50% initial M.C of fresh meat.)	Produces full protein, medium fat coconut flour without testa as a co-product. Long shelf-life of oil: 1 yr and more. Uses mechanical type of equipment to produce the oil.
3. Low pressure method M.C of meat for extraction should be 10-12% for bridge press and DME expeller	FFA : 0.1- 0.2% M.C: 0.17% and above Colour: water- clear Oil recovery: 24.5kg/100kg of fresh milled coconut meat (Based on 50% initial M.C of fresh meat.)	Uses manually operated equipment to produce the oil. Produces a semi-dry coconut residue that has to be further dried or processed to have market value. Shelf-life of oil is very short if not immediately dried by gentle heating after extraction to remove water. *FFA: Free fatty acid; MC: Moisture content

The method is also much simpler, which can be carried out at home by anyone who is interested in producing their own natural oil. The principle of wet extraction method is same as traditional method.

Fermentation method

Fermentation is the addition of yeast or enzyme or microorganism into a feed stock to obtain a desired product. Natural and induced fermentation are the two different methods used for manufacturing VCO.

Among the existing VCO processing technologies, the natural fermentation method has the lowest labour requirement and the least energy input. However, if the fermentation process is not properly controlled, then it produces oil with a sour smell and relatively higher free fatty acid content nullifying the saving in labour costs as the oil cannot be classified as VCO. Precise controls for the maturity of coconuts and the ambient conditions for the fermentation room are necessary to obtain good, high quality oil recovery. The natural fermentation method comprises two distinct parts – extraction or preparation of coconut milk and processing of the VCO from the milk. In natural fermentation method, the coconut milk (1st and 2nd extraction) is allowed to settle for 16 – 24 hrs which will result in the phase separation. There will be three phases: separated oil, the curd and the skim milk. Separated oil is filtered and dried to obtain class A virgin coconut oil. The skim milk is heated and decanted to obtain the class B oil and the residue (latik) is used in animal feeds and the curd is discarded or used as a beverage.

Karim *et al.* (1997) investigated the use of pure culture, Lactobacillus plantarum 1041 IAM to extract coconut oil, which was able to extract as much as 95% of the oil. In the study, grated coconut meat and water at 30, 50 and 70°C were mixed in ratio of 1:1, 1:2 and 1:3 and allowed to settle for 2 to 6 hours. The most efficient coconut cream separation was obtained at the 1:1 ratio of grated coconut meat to water at 70◦c followed by 6 hour settling time. L. plantarum has the ability to ferment sugar with the production of considerable amount of lactic acid. Coconut milk with L. plantarum strain IAM 1041 inoculation indicated a rapid breaking of the emulsion and the liberation of the oil compared to Lactobacillus delbrueckii. This was because L. plantarum strain could multiply faster in coconut milk at 40 - 50◦c under microaerophilic conditions which increased the fermentation process. Coconut milk emulsion can also be separated by adjusting pH of coconut milk emulsion between pH 3 and 5.6 and inoculated with bacteria cultures. Scientists used acetic acid treatments to destabilize coconut cream in coconut oil extraction. Treatment of 25% of acetic acid at level of 0.1, 0.2, 0.3 and 0.4% on coconut cream from 10 to 14 hours of reaction time at room temperature had improved the quality of the oil extracted, with oil recovery upto 60%. Other treatments to break coconut milk emulsion included the use of heat, refrigeration, action of enzymes, acidification, the use of salt or brine, electrolyte action, short waves and combination of these treatments. These techniques were possible due to the capability of coconut milk proteins to coagulate and precipitate at pH of 4.

Centrifugation process

Attempts have been made before to break the protein stabilized oil-in-water emulsion including heating and centrifugation, freezing and thawing, chilling and thawing the coconut cream obtained after centrifugation. Emulsion was centrifuged before chilling and thawing to allow better packing of coconut oil globules.

According to the studies, the temperature used were 10°C and -4°C for chilling and freezing process, respectively while the thawing process was carried out in a water bath at 40°C until the coconut cream reached room temperature (25°C). In addition, this action also help in removing undissolved solids after extraction. The removal of solids present in high percentages in the dispersion of oil seed was important for efficient recovery of oil by centrifugation. The centrifugation step was followed to enable the packing of cream oil globule to crystallize on lowering the temperature. Centrifugation process was carried out from 10,000 rpm to 6 min. During thawing, the oil coalesced due to loss of spherical shape and formed large droplets of varying sizes.

Robledano-Luzuriaga and Krauss-Maffei were two processes known to apply freeze and thaw operation in the extraction of coconut oil. In the Robledano-Luzuriaga process, fresh coconut kernel was comminuted and pressed to obtain approximately equal amounts of emulsion and residue. The residue was pressed again to obtain more emulsion and residue. The emulsion was centrifuged to obtain cream, skim milk and some solids or protein. The cream was subjected to enzymatic action under closely controlled temperature and pH conditions. After freeze-thaw operation, the cream was centrifuged again to obtain the oil. The protein in the skim milk was coagulated by heating, subsequently filtered and dried to produce protein concentrate.

The oil recovery reported in the Krauss-Maffei was 89%, which was less than the conventional expeller process (95%). In this technique, husked coconuts were autoclaved, shelled, and the coconut meat (the white solid endosperm inside the coconut fruit) first sent through cutter and subsequently through a roller mill. Then it was pressed in a hydraulic press and the emulsion was centrifuged to obtain the cream and skim milk. The cream was heated to 92°C and then filtered to obtain high quality oil. The skim milk is heated to 98°C in a

flow heater to coagulate protein, which was separated by centrifuging and then drying. The residue from the hydraulic press was dried and ground to obtain edible coconut flour. The study shows that quite high recovery of oil was obtained but the temperature employed was slightly high which might destroy some of its minor components such as phenolic compounds.

Bawalan Masa process

Bawalan Masa process uses coconut milk residue as the raw material. The residue is blanched and dried at specific moisture content and defatted under controlled conditions. Specially designed equipment produces VCO and low fat, high fibre coconut flakes. The flakes are ground to produce coconut flour with high dietary fibre. Oil recovery of the process is 17 kg/100 kg of wet residue. Hundred kilograms of grated fresh meat generated, 46.7 kg of wet residue which can be further processed to give 7.94 kg extra oil which has a shelf life of more than one year.

Enzymatic extraction method

Extraction of oil can also be carried out by the use of enzymes in aqueous extraction process. This is due to the fact that plant cell walls consists of complex carbohydrate molecules such as cellulose, hemicelluloses, mannans, galactomanans, arabinogalactans, pectin substances and protein. Coconut meat contains about 10% of carbohydrate, in which 50% of this is cellulose and 75% of the cellulose is made up with α -cellulose. Oil can be found inside plant cells, linked with proteins and wide range of carbohydrate such as starch, cellulose, hemicelluloses and pectins. Cell-wall degrading enzymes can be used to extract oil by solubilising the structural cell wall components of the oil seed. Scientists also successfully extracted coconut oil with 1% enzyme mixture of cellulase, α -amylase, polygalacturonase, and protease with an oil yield of 74%. The polygalacturonase hydrolyses α -linkages of polygalacturonic acid of the polymer randomly from the ends. A α-amylase randomly hydrolyzed α -linkages to liquify starch and produced maltose, whereas bacterial proteases were used to hydrolyze the plant protein. The study showed that different enzymes were required to degrade components of the structural cell wall including mannan, galactomannan, arabinoxylogactan and cellulose.

Virgin coconut oil and disease management

Antimicrobial activity of virgin coconut oil:

Lauric acid and capric acid present in virgin coconut oil is responsible for the antimicrobial activity. Lauric acid is converted to monolaurin and capric acid to monocaprin in the body during digestion. Monolaurin and monocaprin are the antiviral, antibacterial, antiprotozoal monoglyceride which destroys the microbes in the body. Monolaurin exerts virucidal and bactericidal effects by solubilising the lipids and phospholipids in the envelope of the pathogen causing the disintegration of its envelope. Antiviral activity of monolaurin is also attributed by its interference with the viral maturation. Recent evidence has also indicated that the antimicrobial effect is related to its interference with signal transduction in cell replication.

Table 2: Micro organisms inactivated by monolaurin

Virus inactivated by monolaurin	Bacteria inactivated by monolaurin
HIV virus Measles virus Herpes simplex virus – I Cytomegalovirus Influenza virus Rubeola virus	Listeria monocytogenes Staphylococcus aureus Streptococcus agalactiae

In addition, a number of fungi, yeasts, and protozoa are reported to be inactivated or killed by monolaurin. Candida albicans and the protozoan parasite Giardia lamblia were both reported to be killed by monolaurin.

Antidepressant and antistress activity of virgin coconut oil

Stress is a feedback survival response that strengthens the physical and mental status of an individual. Physical stress increases the consumption of oxygen which will increase oxidation and creation of free radicals which will lead to neuronal cell damage and death. Virgin coconut oil is also suggested as antistress functional oil. The antistress effect of virgin coconut oil was evaluated by administering at a dose of 10 ml / kg body weight for a period of 7 days. Virgin coconut oil was able to reduce immobility time and restore oxidative stress in mice. Furthermore, mice treated with virgin coconut oil were found to exhibit higher levels of brain antioxidants, lower levels of brain 5-hydroxytryptamine and reduced weight of the adrenal glands. Consequently, the serum cholesterol, triglyceride, glucose and corticosterone levels were also lower in virgin coconut oil treated mice.

Diabetes mellitus and virgin coconut oil

Diabetes mellitus characterized by hyperglycaemia, is due to the deficiency of insulin secretion or its action. Virgin coconut oil is rich in medium chain fatty acids (MCFA). These MCFAs are smaller and are easily absorbed from the stomach and thus it relieves strain on pancreas. Antioxidants may enhance the sensitivity to insulin or otherwise may also reduce insulin resistance and injury to pancreatic beta cells by scavenging reactive oxygen species (ROS) in diabetic patients. Virgin Coconut Oil (10ml per kg body weight) alleviates hyperglycaemia and improves glucose tolerance probably by its antioxidant effect which consequently leads to improvement of insulin secretion.

Renal dysfunction is now a prevalent complication

of diabetes mellitus. Renal dysfunction is the reduced capacity of the kidney to excrete metabolic products which accumulate in the body system and can be detected via renal function test. Diabetes mellitus has degenerating and destructive effects on the kidneys which can lead to renal dysfunction but can be significantly reversed by dietary consumption of virgin coconut oil. Renal dysfunction is caused by the increased blood sugar and superoxide levels in the body. Antioxidants in virgin coconut oil will increase the antioxidant status by elevating the activities of antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidise which will elevate the increased blood sugar and superoxide and thus decrease the risk of renal dysfunction.

Lipid levels and virgin coconut oil

Virgin coconut oil has a significant beneficiary effect on lipid levels and thus lowering the cause of coronary heart diseases. Feeding of virgin coconut oil results in decreased concentration of cholesterol, triglycerides and phospholipids which are due to the relative rate of synthesis and catabolism of these lipids. The minor and unsaponifiable components in virgin coconut oil influence the rate of synthesis and oxidation of fatty acids in liver. They also opined that wet processed VCO has a beneficial effect in lowering lipid components compared to copra oil. The phenolic fraction of virgin coconut oil was also found to be capable of preventing in vitro LDL oxidation with reduced carbonyl formation and the antioxidant activity of the phenolic fraction of VCO against copper induced LDL oxidation confirms the high potential of the oil in protecting LDL against oxidative stress induced by physiological oxidants.

VCO contains more unsaponifiable components such as vitamin E and polyphenols compared to groundnut oil and copra oil and was found to have more inhibitory effect on microsomal lipid peroxidation that prevents lipids peroxidation in both in vitro and in vivo conditions.

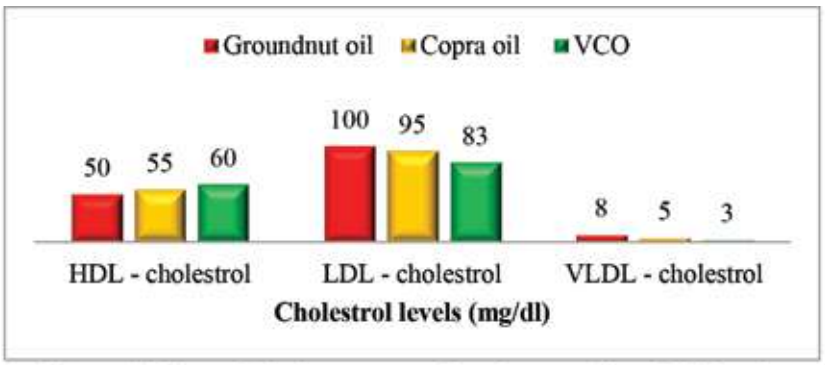


Figure 1: Effect of virgin coconut oil and copra oil on lipid levels

In the study the concentration of cholesterol in serum, liver, and heart of the VCO (8%) treated group was significantly lower compared to copra oil (8%) fed and control (groundnut oil fed) animals. Triglycerides in serum and tissues were significantly lower in VCO treated animals compared to copra oil and control animals and phospholipid levels also showed the same pattern among the three groups. HDL cholesterol in VCO fed animals was increased while LDL cholesterol levels were significantly decreased compared to the other two groups. (Figure 1.)

Cardiovascular diseases and virgin coconut oil

Cardiovascular disease has become the main cause of death worldwide. Hypertension or an increase in blood pressure is one among the factors that cause cardiovascular complications such as coronary heart disease, atherosclerosis and stroke. VCO supplementation prevents the increase in blood pressure. The blood pressure lowering effects of virgin coconut oil is attributable to its high polyphenol component. The short term administration of polyphenolic components reduces blood pressure in normotensive rats. The polyphenols is able to stimulate nitric oxide (NO) released from the endothelium, giving rise to vasodilation and blood pressure reduction. Nitric oxide is a radical which helps in vasodilation. Antioxidant content in virgin coconut oil is capable of providing protection effects by reducing oxidative stress and thus maintaining the nitric oxide bio availability.

Atherosclerosis

Oxidation of low density lipoprotein is a risk factor for atherosclerosis and coronary heart diseases. Lipid peroxidation is involved in the oxidative modification of LDL. The polyphenolic compounds present in virgin coconut oil trap reactive oxygen species in aqueous components such as plasma and interstitial fluid of the arterial wall thereby inhibiting the LDL oxidation and shows antiatherogenic activity. There are suggestions that the higher polyphenolic fraction of virgin coconut oil is responsible for its anti inflammatory and antioxidant effects, which will contribute towards the prevention of cardiovascular diseases by preventing the progression of atherosclerosis.

Obesity and virgin coconut oil

The modernization of society with reduced levels of physical activity and increased dietary intake of carbohydrate and highly saturated fat accounted for the rapid growth in obesity epidemic.

Virgin coconut oil supplementation causes a decrease

in body weight. Medium chain fatty acids increase energy expenditure and results in faster satiety. The fat content helps to slow down the emptying of the stomach. VCO naturally contains a mixture of medium chain fatty acid and long chain fatty acid in a ratio of 3: 1. MCFAs are rapidly absorbed in the intestines even without catalyzation by the pancreatic lipase enzyme. LCFAs, on the other hand, required pancreatic lipase for absorption. They are carried by the lymph to the systemic circulation in chylomicrons and eventually reach the liver where they either undergo beta oxidation, biosynthesis to cholesterol, or are repackaged as triglycerides. MCFAs are carried by the portal vein to the liver where they are rapidly oxidized to energy. Unlike LCFAs, MCFAs do not enter the cholesterol cycle and they are not deposited in fat depots. Therefore, virgin coconut oil is utilized for energy and is less likely to get stored as fat, and this explains why it is able to reduce the abdominal obesity in humans and thus the body weight.

The fat accumulating in the abdomen, known as visceral adiposity was associated with increased cardiovascular risk, insulin resistance, and dyslipidemia. VCO is efficacious for waist circumference reduction especially in males and it is safe for use in humans. In the study, the subjects were prescribed with VCO (30ml per day taken in three divided doses, half an hour before each meal) 1 week after initial evaluation and continued over the next four weeks. In the parameters that was studied a significant decrease was seen in the waist circumference, triglyceride and total cholesterol, which attributes to reduction in visceral adiposity and thus to obesity (Table 3).

Table 3: **Changes in physical and biochemical parameters of obesity after administration of VCO**

Parameters	First Week	Sixth Week
Weight (kg)	82.77	82.53
Body mass index (kg/m2)	32.51	32.40
Waist circumference (cm)	102.64	99.78
Waist – hip ratio	0.92	0.91
Body fat percentage (%)	39.91	39.31
Fat mass (kg)	33.33	32.78
Fat – free mass (kg)	49.20	49.77
Triglyceride (mg/dl)	120.45	108.05
Total cholesterol (mg/dl)	211.13	206.88
LDL (mg/dl)	128.77	125.67
HDL (mg/dl)	58.77	59.93

Bone health and virgin coconut oil

Osteoporosis is a chronic systemic skeletal disease characterised by a low bone mass and loss of bone tissue and micro-architecture. The bone becomes weak and fragile with a consequent increase in the fracture incidence. Reduction in estrogen level is the major cause of bone loss in postmenopausal osteoporosis. The imbalance between oxidative stress and antioxidant agents leads to enhancement of osteoclast activity and inhibition of osteoblast activity. Diet rich in antioxidants is considered as a novel therapeutic agent in prevention and treatment of postmenopausal osteoporosis. Virgin coconut oil can prevent lipid peroxidation and increase the antioxidant enzymes in the osteoporotic rats. Therefore, supplementation of antioxidant enriched diet as virgin coconut oil may shed light on the development of new alternative therapy for postmenopausal osteoporosis and prevention of fractures.

Various authors opined that virgin coconut oil effectively improved bone structure and prevented bone loss in osteoporosis rats. The beneficial effects of virgin coconut oil on bone micro architecture may be due to the high polyphenols which exert antioxidant property. Virgin coconut oil could offer an interesting approach to prevent accelerated bone loss in osteoporosis especially in postmenopausal women. In the study, 40 rats were randomly divided into four groups: Baseline, ovariectomised control, ovariectomised and treated with virgin coconut oil (8%) and ovariectomised and given calcium (1%). The bone volume of VCO fed rats had a bone volume same as that of a normal rat and was higher than that of overiectomied control and overiectomise and fed calcium (figure 2).

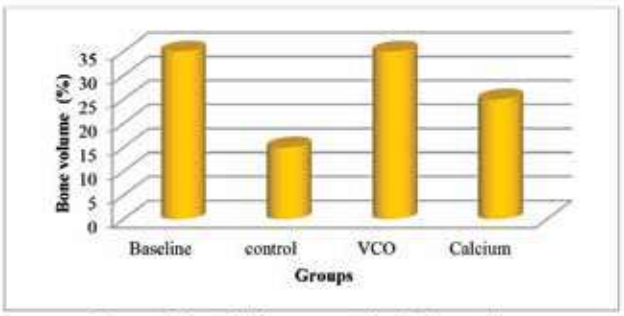


Figure 2: Effect of virgin coconut oil on the bone volume

Liver and virgin coconut oil

Liver is the largest organ in the human body and key organ of metabolism, including glycogen storage, decomposition of red blood cells, plasma protein synthesis and detoxification. The digestion and metabolism of medium chain fatty acids in VCO are significantly different from other fatty acids commonly found in the diet. They do not need bile for digestion and put little strain to the enzymes and digestive system

of the body. Once they pass through the stomach they are immediately absorbed into the portal vein and channeled directly to the liver. In the liver, they are used preferentially as a source of fuel to produce energy. Therefore, VCO consumption improves the normal functioning of liver. It can also be used during jaundice, as it doesn't need bile acids for digestion and pose less strain on liver, thus improving the disease condition.

Virgin coconut oil as ocular rewetting agent

Virgin coconut oil is safe to be used as ocular rewetting agent in human being. Dry eye is multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance and tears film instability with potential damage to the ocular surface. It is accompanied by an increase osmolarity of the tear film and inflammation of the ocular surface. Several brands of artificial tears are said to improve the situation but gives only temporary relief. The beneficial effect of virgin coconut oil is most likely attributed to its anti inflammatory properties, which is similar to those of natural tears.

Virgin coconut oil and Alzheimer's disease

Alzheimer's disease is a common age associated progressive neurodegenerative disease. studies show that addition of virgin coconut oil (20 mg/day) is likely to have beneficial effects in cognitive performance for those suffering from moderate to severe Alzheimer's disease and the effects were sustained for at least 2 weeks after the oil administration stopped. No deleterious effects on the overall lipid profile could be elicited.

Virgin coconut oil and pregnancy, lactation, infancy

Virgin coconut oil is found to be safe for consumption by pregnant and lactating women. Consumption of VCO or coconut products (such as milk and coconut oil) by pregnant women and lactating women has a positive effect for the baby. VCO by pregnant and nursing mothers can expedite the process of birth in pregnant women and increase breast milk in nursing mothers. In a study done in 20 lactating mothers and their infants found that the mothers fed with 15ml of virgin coconut oil thrice a day along with normal diet had an increase in the secretion of breast milk. It is due to the ability of virgin coconut oil as the analgesic effect that gives a sense of relaxation. There was an increase in the medium chain fatty acid content in the breast milk which can enable a better growth for the infants and the infants had an increase of weight, height and head circumference than the infants of mothers not fed with virgin coconut oil.

Recommended dosage

A daily intake of 15 – 20ml of virgin coconut oil is the recommended dosage for adults including pregnant and nursing mothers. Two ml of virgin coconut oil twice a day added in the milk is recommended for infants.

Products and byproducts of virgin coconut oil

Virgin coconut oil is used in the manufacture of many products such as soaps, baby soaps and creams, hair oils, massage oils, tooth paste, lipsticks, body creams, moisturising creams etc. The emerging product is the encapsulated virgin coconut oil made by encapsulating 1g oil with gellan gum. The by-products of virgin coconut oil are coconut milk residue, class B virgin coconut oil and coconut meat. These are also utilised in various products like soaps, creams, desiccated coconut and animal feed.

Commercially available virgin coconut oils in Kerala : CDB Institute of Technology, Alwaye., Krishi Vigyan Kendras and CPCRI, Kasargod is giving training in the production of VCO

VCO is the oil obtained from the fresh mature coconut kernel. The polyphenols and medium chain fatty acids is responsible for the beneficiary effect in managing the communicable and non communicable diseases. A daily intake of 15 - 20 ml/day and 2ml/day of VCO is the recommended dose for adults and infants respectively. Apart from the use as oil it is also used in the manufacture of many products as soaps, creams, lipsticks etc. Another emerging product is the encapsulated VCO made by encapsulating 1g oil with gellan gum. The market price of VCO varies from Rs 440 to 680 per litre ■

Table 4: **Commercially available virgin coconut oils in Kerala**

Product name	Manufacturing unit and place	Methods employed	Price / litre (Rs.)
KVK's VCO	KVK, Kannur	Traditional method	600
Subhicsha	Subicsha coconut producers company ltd., Kozhikode	Traditional method , DME	600, 400
Real VCO	Kerala Dinesh, Kannur	Traditional method	550
Rubco nutriko	Kerala state rubber Co-operative Ltd, Kannur	Cold pressed method	480
Virgin plus	Keratech, Engandiyoor	DME	440
Kakapuram	KVK, Allapuzha	Traditional method	600

Fair Sangam 2016

Union Agriculture Minister, Shri. Radha Mohan Singh and other dignitaries tasting Neera, during the Fair Sangam 2016

Coconut Development Board participated in Fair Sangam 2016 at Navsari, Navsari Agricultural University Gujarat on 5th and 6th June 2016, organised by National Horticultural Board. Shri. Radha Mohan Singh, Union Minister for Agriculture and Farmers Welfare, Govt of India inaugurated the programme on 5th June 2016. Shri Nanubhai Bhagavanbhai Vanani, Minister of Sports, Govt of Gujarat, Shri. Chandrakant Raghunath Patil, Member of Parliament Navsari, Dr. C.J Dangaria, Vice Chancellor, Navsari Agricultural University and Shri. Ravi Kumar Arora, IAS,Dist Collector, were present during the occasion.

CDB displayed wide range of coconut value added products, varieties of coconut seedlings and coconut bunches in the show. State Horticulture Mission, State Horticulture/ Agriculture Departments, NGOs and progressive farmers participated in the show along with various farm produces.

Hon'ble Ministers and other VIPs visited CDB stall along with Dr. A.K Singh, Chairman, CDB. More than fifty thousand visitors including farmers, students and general public visited the two day Sangam.

A view of CDB stall in Fair Sangam 2016

A view of the meeting

Maharashtra Minister, Deepak Kesarkar visited CDB

Shri. Deepak Kesarkar, Hon'ble Minister of State for Finance, Planning and Rural Development Govt. of Maharashtra and a team of senior officials from Agriculture and Rural Development departments of Maharashtra visited Coconut Development Board, Kochi on 22nd June 2016 as part of the convergence of schemes for the development of coconut farming and industry in Maharashtra. The Minister held discussions with Dr. G R Singh, CCDO, Dr. A.K. Nandi, Secretary, senior officers of CDB, and Directorate of Cashew and Cocoa Development.

Shri. R Jnadevan, Deputy Director, CDB made a presentation on the schemes of CDB and the action initiated for the development of coconut in Sindhudurg district, like Area Expansion Scheme of the Board in convergence with MGNRES scheme, establishment of Regional Coconut Nursery (RCN) at college of Horticulture, Mulde to produce one lakh coconut seedlings per year, establishment of five Nucleus Seed Gardens and 10 small coconut nurseries , strengthening of hybridisation programme for the production of hybrid Konkan Bhatye CH1 (GBGD X ECT) released by RFRS, Bhatye to meet the local demand, creation of irrigation facilities in coconut gardens, promotion of intercropping, exposure visit to Pollachi, Tamil Nadu and visit to various Coconut Producer Companies in Kerala, training unemployed youths for FOCT, training 100 Neera Technicians, Formation of FPOS etc.

Earlier in January 2016, the Hon'ble Minister had visited CDB and expressed interest to develop coconut plantations with suitable high value intercrops in the coastal belt of Maharashtra especially in Sindhudurg district. Accordingly a of team of officers from CDB visited Sindhudurg and attended the review meeting at Regional Fruit Research Station (RFRS), Vengurle and a workshop at Sindhudurg Collectorate. Action was initiated for the convergence of schemes. The team also visited Spices Board and Coir Board as part of integration of schemes.

Project Approval Committee cleared 18 projects worth Rs. 12.76 crores

A view of the 48th PAC meeting

Coconut Development Board (CDB) in its 48th meeting of the Project ApprovalCommittee (PAC) on Technology Mission on Coconut (TMOC) held at Kochi on 15th June 2016 under the Chairmanship of Dr. A.K. Singh, Chairman, CDB approved 18 projects with an outlay of Rs. 12.76 crores and financial assistance of Rs. 2.75 crores. CDB Institute of Technology, South Vazhakulam, Aluva, Kerala has developed four flavours of coconut milk, a 'ready to drink juice' in lab scale. PAC has sanctioned Rs. 52.20 lakh for pilot testing of the product. Under the sub component Processing and Product Diversification 5 projects for Desiccated Coconut Powder for processing 300 lakh nuts per year, 3 Virgin Coconut Oil units for processing 105 lakh nuts per year, one Coconut based foods unit with a capacity to process 2 lakh nuts per year, 2 Copra Dryer units with processing capacity of 60 lakh coconuts per year, 4 Ball copra making units with processing capacity of 26 lakh coconuts per year and 2 Shell Charcoal units with a capacity for produce 3300 MT Shell Charcoal per year were sanctioned. In Kerala, One Virgin Coconut Oil processing unit with a capacity to process 5,000 nuts per day, one Coconut based food unit for processing 600 coconut per day, 2 Desiccated Coconut Powder making units with a capacity to process 30,000 nuts per day and 2 copra dryer units with a capacity to process 20,000 coconuts per day were sanctioned. In Karnataka, 2 Desiccated Coconut Powder processing units with a capacity to process 45,000 nuts per day were sanctioned. In Tamil Nadu, one Desiccated Coconut Powder processing unit with a capacity to process 25,000 nuts per day, 2 Virgin Coconut Oil units for processing 30,000 coconut per day and one Coconut Shell Charcoal manufacturing unit to produce 10 MT Shell Charcoal per day were sanctioned. In Maharashtra one Coconut Shell Charcoal manufacturing unit to produce one MT Shell charcoal per day was sanctioned. | In Andhra Pradesh, 4 Ball Copra making units with a capacity to process 26 lakh coconuts per year were sanctioned. Mr. Venkatesh N Hubballi, Director, Directorate of Cashew and Cocoa Development, Kochi; Dr. V. Krishna Kumar, Head, Regional Station, ICAR-CPCRI, Kayamkulam; Dr. Anil Kumar R., Assistant Agricultural Marketing Advisor, Directorate of Marketing and Inspection, Kochi; Dr. P.Vijayaraj, Scientist, CFTRI, Mysore; Dr. V. Rajaraman, AGM, NABARD, RO, Thriuvananthapuram; Mr. B. Sasidharan, Chief Manager, IOB, Kochi; Ms. Jessy KX, Joint Director of Agriculture, Govt. of Kerala, Thiruvananthapuram; Dr. G.R.Singh, Chief Coconut Development Officer, CDB, Kochi, Dr. A.K. Nandi, Secretary, CDB, Kochi, Shri R. Jnanadevan, Deputy Director, CDB, Kochi, Shri Sardar Singh Choyal, Deputy Director, CDB, Kochi and Shr. A Jeyapandi, Deputy Director, Marketing, Regional office, Chennai, attended the meeting. Dr. D.M. Vasudevan, Former Principal, AIMS, Kochi attended the meeting as an expert member.

Chairman CDB visited Karappuram Coconut Producer Company

Dr. A K Singh, Chairman, Coconut Development Board visited Karappuram Coconut Producer Company Ltd and farmer's field where the Replanting and Rejuvenation programme of coconut garden is being directly implemented by the Board. Adv. Priyesh Kumar, Chairman, Dr.P K Mani, CEO and Shri. T S Viswan, Director Karappuram CPC received Dr. A K Singh and discussed about the schemes and activities of CPC.

Karappuram CPC is producing neera, virgin coconut oil and various other value added products. Chairman, CDB visited the neera plant of the CPC and appreciated the activities of CPC. He called upon the farmers to take up initiatives for producing and marketing these products both in the domestic and international market. He also suggested to explore the possibilities of making contract with Indian railways for marketing the products.

Dr. Singh visited farmer's field to see neera tapping and had interaction with neera technicians. Chairman, CDB also visited farmer's field where integrated farming is undertaken. Dr. Singh further visited the coconut garden of Marari Beach Resort Aleppey. Dr. Singh was accompanied by Dr. G R Singh, Chief Coconut Development Officer, and Shri. Sasikuamr C, Technical Officer, CDB, Kochi. ■

Retirement

Shri. Rajeev P George, Director retired from the service of Coconut Development Board on 31st May 2016. Shri. Rajeev P George joined the Board's Patna office in 1985 and has served in Andaman and Nicobar Islands, Tamil Nadu and Assam offices of CDB in various capacities.

Shri. K N Vijayakumaran Nair, Stenographer retired from the service of Coconut Development Board on 31st May 2016. Shri. Vijayakumaran Nair joined the Board's Guwahati office in 1985 and has served the Board at its Vijayawada and Hyderabad offices.

Krishi Fair 2016

Coconut Development Board, State Centre, Pitapally, Odisha participated in the 7th Krishi Fair 2016 from 4th-8th June, 2016 at Puri organised by Shree Shrikshetra Soochana, Puri, Odisha. The programme was inaugurated by Shri. Pradip Maharathi, Agriculture Minister, Govt. of Odisha, in the presence of Ex-Chief Minister of Odisha Shri Giridhara Gnmango, Shri A.V.Swamy Hon'ble MP, Rajyasabha, Padmashree awardee Shri Haladhar Nag, & Shri Dibakar Patra, Zilla Parishad Chairman, Puri.

Board displayed coconut seedlings of different varieties, coconut palm climbing machine, different coconut varieties, various value added products like virgin coconut oil, virgin coconut capsule, desiccated coconut, coconut milk, coconut jam, squash, coconut oil, coconut milk powder, handicrafts items, informative posters on coconut products, Board's schemes, activities etc. The Chief Guest and other dignitaries were received in the Board's stall by Shri M.K.Singh, Deputy Director i/c CDB. Queries on availability of coconut seedling, CPS formation, coconut related industries etc. were answered by Board's officials. Shri Virendra Singh, Addl. Commissioner, Dept. of Agriculture & Co-operations visited Board's stall.

Shri M.K.Singh, Dy. Director i/c CDB, Dr. H.S Singh, Head CHES, Shri Virendra Singh, Addl. Commissioner, Dept. of Agriculture & Co-operations , Shri Bani Singh, Dy.Director, NHB & Shri. Madhab CH. Sahoo, CDB, Odisha, in the Board's stall

Kum. Sasmita Pallei,CDB , receiving memento & certificate for the best stall in the show.

A view of Board's stall

Central/state govt. organisations, Nationalised Banks, NGOs, SHGs, Fertiliser Companies, Agricultural Machinery Manufactures, Publishers, organic farming related enterprisers and seed companies participated in the exhibition.

The valedictory session was held on 8th June, 2016. Shri Rajesh Kumar Mohanty, General Secretary, Shree Shrikshetra Soochana, Puri awarded certificates and mementos to the participating organisations and appreciated the interest of agricultural organisations to disseminate knowledge and new findings through exhibitions and fairs.

Thousands of visitors attended Krishi Fair 2016. Participation in 5 days 'Krishi Fair 2016' helped to create awareness about coconut cultivation technology and activities and schemes of the Board. ■

Monthly operations in the coconut gardens- July

Andaman & Nicobar Islands: Open basins around palms of a radius of 2m from the base of the palm. Apply 25 to 50 kg of cattle manure or compost and 10-20 kg of ash per tree and cover the basins with soil. Remove the weeds in the nursery.

Andhra Pradesh : Continue manure application if not done during June. Plant seedlings in the main field. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20 g garlic emulsion + 5 g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Assam : Do not allow rain water to accumulate in the pits of transplanted seedlings. Clean the crowns of the palms. If stem bleeding disease is noticed, (1) remove the affected tissues of the stem and apply 5 percent calixin on the wound. When this is dry apply warm coal tar (2) root feed the affected palm with 5 ml calixin in 100 ml water per palm at quarterly intervals (3) apply 5 kg neem cake per palm per year along with the organic manure during the post monsoon period (4) regulate field regime by providing proper drainage during rains and irrigating the palms during summer. If bud rot disease is noticed, remove and clean the infected tissues and apply Bordeaux paste on the affected portion. The treated portion should be given a protective covering to prevent washing out of the paste during rains. Spray the neighbouring plants with one percent bordeaux mixture. Adopt plant protection measurers when the weather is clear. Remove the weeds from the nursery.

Bihar / Madhya Pradesh/ Chhattisgarh : Provide proper drainage. Do not allow rain water to accumulate for a long time in the pits. Transplant selected good quality seedlings in the already prepared and half filled pits. Drench the basins of transplanted seedlings with 0.05 percent chlorpyriphos twice at 20 to 25 days interval against the attack of termites. Apply 2 kg bone meal or single superphosphate in the pit before planting. Open the basins around the palm of a radius of 2m upto a depth of 15-20 cm, and apply manures and fertilizers and cover with soil.

During this month apply 30-50 kg farmyard manure/ compost per palm in the basin before the application of fertilizers. In irrigated and well maintained gardens apply the fertilizers @ 275g of urea, 500g single super phosphate and 500g muriate of potash. In rain fed gardens apply the first dose (1/3 of the recommended dose) of fertilizers i.e. 250g urea, 350g single superphosphate and 400 g muriate of potash, per adult palm and cover with soil. The gaps caused by the death of seedlings (previous

year's planting) should be filled up, preferably with polybag seedlings. Similarly, remove all unhealthy and defective seedlings and replant with healthy seedlings. Check the palms for bud rot. If bud rot is found, remove the affected parts and apply bordeaux paste. Spray the neighbouring palms/ seedlings with 1 per cent bordeaux mixture.

Karnataka : Open circular basins around the palm, of a radius of 2m. Take appropriate control measures if attacks of rhinoceros beetle and red palm weevil are noticed. Keep the garden free of weeds. Give a prophylactic spray with 1 per cent bordeaux mixture if not given during the last month. Seedlings can be planted during this month. If the attack of the mite is noticed, spray neem oil - garlic – soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Kerala/Lakshadweep : Open basins around the palms, of a radius of 2 m and fill them with green manure cuttings or green leaves @ 25kg per palm or bulky organic manures like cowdung, compost, etc.@ 50kg per adult palm and close the basins partially, if not done in June. Clean the pits in which seedlings have been planted. Search the crowns of trees for rhinoceros beetle, red palm weevil and also for bud rot disease. Take steps to check them. Clean the crown of the palm. If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water. Remove the weeds from the nursery.

Maharashtra/ Goa/ Gujarat : Bury husk in trenches between palms with concave side up. A prophylactic spray with 1 per cent bordeaux mixture may be given against fungal diseases.

Orissa : As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year. Hook out the rhinoceros beetles. Manure vegetables and other crops. Give a prophylactic spray with 1 per cent bordeaux mixture against fungal diseases.

Tamil Nadu/ Puducherry : Open basins around the palms. Keep the garden free of weeds. Give the palms a prophylactic spray with one per cent bordeaux mixture to prevent bud rot and other fungal diseases. Apply the first dose of fertilizers i.e. 300g urea, 500g single superphosphate and 500 g muriate of potash per adult palm if not applied during last month. Search for rhinoceros beetle on the crowns of the palms with the beetle hook and kill the beetles. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls (12g/ palm) and cover them with sand thrice a year. Planting of seedlings in the main field can be done during this month. Search palms affected by Thanjavur wilt and take appropriate management practices. If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20g garlic emulsion + 5g soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Tripura : Basin around the palm should be cleaned by removing the weeds. Green manure crops sown in May if any, should be ploughed and incorporated during the month. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/ palm) and cover them with sand thrice a year. Collected seed nuts may be sown in seed beds without delay by taking advantage of the rain.

West Bengal : Apply green manure at the rate of 25 kg per palm. Keep the garden free of weeds. Start planting of seedlings in the main field. A prophylactic spray of 1 percent bordeaux mixture against fungal diseases may be given. ■

MARKET REVIEW – MAY 2016

Highlights

- The prices of milling copra and coconut oil expressed an erratic trend in major markets in the country during May, 2016.
- The international price of coconut oil & copra expressed an erratic trend during the month of May 2016 compared to the previous month.

The month of May 2016 witnessed a fluctuating trend in the prices of coconut, copra and coconut oil at all important markets in the country.

Coconut Oil

The price of coconut oil opened at Rs.9000 per quintal at Kochi market and ruled at the same price till 6th. On 7th the price declined to Rs.8900 per quintal, thereafter expressed a downward trend till the end of the month and closed at Rs.8200, with a net loss of Rs.800 per quintal. The price of coconut oil at Alappuzha market opened at Rs.9100, declined to Rs.9000 on 3rd and ruled at the same price till 8th. On 9th the price again declined and reached at Rs.8900, thereafter expressed a downward trend and closed at Rs. 8200 with a net loss of Rs.900 per quintal. At Kozhikode market, the price opened at Rs.8900, declined to Rs.8800 on 3rd and thereafter expressed a declining trend throughout the month. The price closed at Rs.8600 with a net loss of Rs.300 per quintal. The monthly average price of Rs.8558 per quintal at Kochi market and Rs.8585 per quintal at Alappuzha market were marginally lower than that of the previous month and respectively 38 percent and 36 percent lower than the corresponding month last year. The monthly average price of Rs.8677 per quintal at Kozhikode market was marginally higher than that of the previous month and 39 percent lower than that of the corresponding month last year. The monthly average price of Rs.7478 per quintal at Kangayam market in Tamil Nadu was 5 percent lower than that of the previous month and 40 percent lower than that of the corresponding month last year.

Milling Copra

The price of FAQ copra opened at Rs.6050 per quintal at Kochi market and ruled steady at same price till 6th. On 7th it declined to Rs.5850 per quintal, then expressed a declining trend and closed at Rs.5250 with a net loss of Rs.800 per quintal. The price of Raasi Copra at Alappuzha market opened at Rs.5850 per quintal, on 3rd it declined to Rs.5800 and thereafter expressed a downward trend throughout the month. The price closed at Rs.5200 per quintal with a net loss of Rs.650. The price at Kozhikode market opened at Rs.5600 per quintal, on 3rd it declined to Rs.5500, thereafter depicted a gradual declining trend and closed at Rs. 5250 with a net loss of Rs. 350. The monthly average price of Rs.5549 at Kochi market , Rs.5442 at Alappuzha market , Rs.5365 at Kozhikode market were 3 to 4 percent lower than that of the previous month and about 40 to 42 percent lower than that of the corresponding month last year. The monthly average price of milling copra at Kangayam market in Tamil Nadu was Rs.5178 per quintal which was 5 percent lower than that of the the previous month and 39 percent lower than that of corresponding month last year. The monthly average price of milling copra at Ambajipetta market in Andhra Pradesh @ Rs. 4796 per quintal was marginally lower than that of the previous month and about 45 percent lower than that of the corresponding month last year.

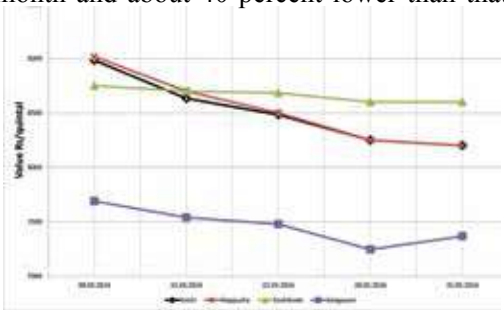
Edible Copra

The monthly average price of Rajapur copra at Kozhikode market @ Rs.7967 per quintal was 5 percent lower than that of the previous month and about 44 percent lower than that of the corresponding month last year.

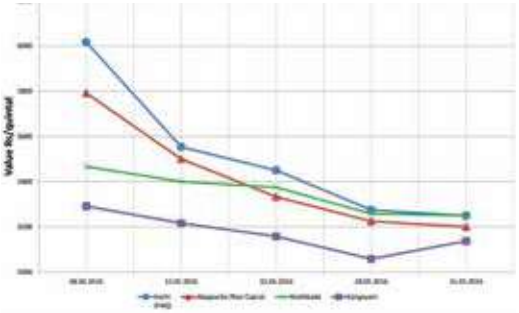
Ball Copra

The monthly average price of ball copra at Kozhikode market @ Rs.6854 per quintal was 7 percent lower than that of the previous month and about 46 percent lower than that of corresponding month last year.

The monthly average price of ball copra at Tiptur APMC market in Karnataka was Rs.7947 per quintal which was about 10 percent lower than that of the previous month and about 40 percent lower than that



Price behaviour of coconut oil during May 2016



Price behaviour of copra during May 2016

of the corresponding month last year. The monthly average price of ball copra at Arsikere APMC market in Karnataka was Rs.7858 per quintal, which was about 9 percent lower than that of previous month and about 37 percent lower than that of the corresponding month last year. The monthly average price of ball copra at Bangalore APMC market was Rs.11925 per quintal which was 8 percent lower than that of the previous month and 28 percent lower than that of corresponding month last year.

Dry Coconut

The monthly average price of Rs.6124 per thousand nuts of dry coconuts at Kozhikode market was 11 percent lower than that of the previous month and about 43 percent lower than that of the corresponding month last year.

Coconut

The monthly average price of partially dehusked coconut at Nedumangad market was Rs.8000 per thousand nuts. This was marginally lower than that of the previous month and about 50 percent lower than that of the corresponding month last year.

The monthly average price of partially dehusked coconut at Arisekere APMC market in Karnataka was Rs.9220 per thousand nuts. This was three percent higher than that of the previous month and 31 percent lower than that of the corresponding month last year.

The monthly average price of partially dehusked coconut at Bangalore APMC market in Karnataka @ Rs.11958 per thousand nuts was seven percent lower than that of the previous month and about 31 percent lower than that of the corresponding month last year. The monthly average price of Grade-1 quality partially dehusked coconut at Mangalore APMC market was Rs.15000/- per thousand nuts, which was same as that of the previous month and about 15 percent lower than that of the corresponding month last year.

Tender coconut

The monthly average price of Tender coconut at Maddur APMC market in Karnataka was Rs.10000 per thousand nuts, which was three percent lower than that of the previous month and also than that of the corresponding month last year.

International

The International monthly average price of coconut oil at Philippines (C.I.F. Rotterdam) market was US$ 1444 per MT. This was about 9 percent lower than that of previous month and about 27 percent higher than that of the corresponding month last year. The monthly average price of US$ 963 per MT copra was 12 percent lower than that of the previous month and 29 percent higher than that of the corresponding month last year.

The domestic price of coconut oil during the month of May 2016 in Philippines was US$ 1418 per MT and in Indonesia the price was US$ 1397 per MT. The international price of Palm oil was US$ 703 per MT, Palm kernel oil (RBD) US$ 1222 MT and Soybean oil US$ 798 per MT during May 2016.

Desiccated coconut

The price of desiccated coconut at Philippines market was US$ 2392 per MT during the second week, US$ 2475 per MT during the third week and US$ 2475 per MT during last week. The price of desiccated coconut at Indonesia market opened at US$ 2095 per MT and ruled at same price during the month of May 2016. In Sri Lanka market price was US$ 2069 during the second week and US$ 2080 per MT during the third week and US$ 2121 per MT during the last week.

The average FOB price of desiccated coconut in India during the month of May was much lower than the international price and the FOB prices of major desiccated coconut exporting countries. During the first week it was equivalent to US$ 1404 per MT, US$ 1563 per MT in the second week, US$ 1520 per MT in the 3rd week and US$ 1531 per MT in the fourth week. The average FOB during the last week was equivalent to US$ 1505 per MT.

Prices of coconut oil , copra and coconut at various marketing centres during May 2016

Date	Coconut Oil (₹/Qtl)				Milling Copra (₹/Qtl)					Edible Copra (₹/Qtl)	Ball Copra (₹/Qtl)				Dry Coconut	Coco-nut	Partially dehusked Coconut (₹/1000 nuts)		
	Kochi	Alappu-zha	Kozhi-kode	Kan-gayam	"Kochi (FAQ)"	Alappu-zha (Rasi Copra)	Kozhi-kode	Kan-gayam	Amba-jipeta	Kozhi-kode	Kozhi-kode	Tiptur	Ban-glore	Ar-sikere	Kozhi-kode	Nedu-man-gad	Ar-sikere	Banglore	Mangalore (Grade-1)
5/8/2016	8983	9017	8750	7689	6017	5792	5467	5292	5250	7933	6833	8113	12800	8000	6267	8000	9788	12833	15000
5/15/2016	8633	8700	8700	7539	5553	5500	5400	5217	5167	8125	7017	8292	0	8275	6053	8000	9000	12000	15000
5/22/2016	8483	8500	8683	7478	5450	5333	5375	5158	4500	8083	6983	7908	11750	7988	6117	8000	9250	12000	15000
5/22/2016	8250	8250	8600	7244	5275	5225	5258	5058	4500	7900	6767	7744	11750	7663	6133	8000	8652	11500	15000
5/31/2016	8200	8200	8600	7366.5	5250	5200	5250	5137.5	4500	7450	6300	7565	11750	7430	5900	8000	8000	10500	15000
Average	8558	8585	8677	7478	5549	5442	5365	5178	4796	7967	6854	7947	11925	7858	6124	8000	9220	11958	15000

Source: Kochi: Cochin Oil Merchants Association and Chamber of Commerce, Kochi - 2, Kozhikode: The Mathrubhumi daily
Alapuzha: The Malayala Manorama daily, Arsikere : APMC, Arsikere. Price quoted for office pass copra at Kozhikode and Rasi copra at Alappuzha markets.