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Introduction

Coconut is one of the most useful crops to mankind in the plant kingdom because of its multifaceted uses of its products; it is called the Kalpavriksha or Tree of abundance. It is an important food crop of economic importance to many of the Asian and Pacific countries in the world. The crop provides livelihood security and employment opportunities to a major segment of the rural mass of these countries. India being the largest coconut producing country in the world occupies 31% of global production. Coconut palm provides food security and livelihood opportunities to more than 12 million people in India. It is also a fiber-yielding crop. More than 15,000 coir based industries provides employment to nearly six lakhs workers of which 80 per cent are women folk. The crop contributes around Rs.2,50,000 million (US\$ 3788 M) to the country's GDP and earns export revenue of around Rs.43,654 million (US\$ 661 M). Coconut and coconut products are gaining global importance as a contributing factor to the health, nutrition and wellness of human beings. This is due to its multiple medicinal and nutraceutical properties being revealed day by day. This new development in health sector has brought in unprecedented increase in demand of coconut products in domestic and international markets. It is estimated that there are five million coconut holdings and 12 million farmers in the country covering 17 states and three Union Territories. This country paper mainly encompasses the major developments in Indian coconut sector along with other salient outcomes.

In India, coconut is predominantly a small holders crop where about 98% coconut holdings are owned by small and marginal farmers. As per the All India estimate for the year 2016-17, the area and production of coconut in the country is 2.096 million

hectares and 22237.99 million nuts respectively. In comparison to the figures of the previous year, the area under coconut cultivation and coconut production increased by 0.39 per cent and 0.32 per cent, respectively.

India, the largest producer of coconut in the world is having sufficient raw material surplus, good reputation in global markets and access to good technologies (Virgin Coconut Oil, Packed Tender Nut Water, minimally processed Tender Coconuts, Activated Carbon). The presence of dominant ethnic population in the Gulf, UK and US are the strengths of India. India is having good network of organizations for conducting research in coconut. Central Plantation Crops Research Institute (CPCRI) was established in 1970 as one of the agricultural research institutes under the Indian Council of Agricultural Research (ICAR) and an International Coconut Gene Bank for South Asia (ICG-SA) was established at Kidu, Karnataka in 2013. The Research Centre at Kidu helps to cater to the needs of the farmers by supplying elite planting materials of the mandate crops, in addition to serving as the International Coconut Gene Bank for South Asia.

The All India Coordinated Research Project on Palms, started in the year 1972, is coordinating research in coconut, oil palm and palmyra under different agro-climatic regions for the identification of location specific technologies. The project provides adaptive research support for coconut through collection, conservation, cataloguing and evaluation of germplasm, evaluation of new hybrids and high yielding varieties of coconut, standardization of agro-techniques for various agro-climatic regions including development of appropriate farming systems and development of efficient pest and disease management strategies.



Coconut Production in 2015 -17 forecast for the year 2018

As per the statistics of APCC for the year 2015, India tops world production of coconut with 20440 million nuts. As per the latest data of the Government of India, 22237.97 million coconuts (2835 MT of copra equivalent) are produced in the country. Over the period from 2012-13 to 2016-17 coconut production in the country decreased by 1.95% from 22,680.03 million nuts to 22,237.99 million nuts. Droughts resulted by insufficient monsoon in major coconut growing states coupled with natural calamities like cyclonic storms and effect of pests and diseases attributed mainly to this decrease.

The four southern states, Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh accounted for 89 percent of the coconut area and 91 percent of the coconut production in the country. Kerala, with the largest area under coconut cultivation and production accounted for 36.86 percent of the area under the crop and 33.57 percent of production at national level.

The productivity of coconut at national level for 2016-17 is 10,611 nuts per hectare. The highest yield is reported from Chhattisgarh at 16508 nuts per hectare followed by Andhra Pradesh (13759 nuts/ ha) and Tamil Nadu (13423 nuts/ ha). Andhra Pradesh and Tamil Nadu out perform to about 40 % over the other two major coconut growing states of Karnataka (9744 nuts/ ha) and Kerala (9663 nuts/ ha).

As per 2015 statistics, India contributes 30.49% of world coconut production and enjoys the first position in terms of production. 75.60 % of area under coconut and 74.55 % of production are contributed by three leading coconut growing countries viz., India, Indonesia and Philippines. India ranks second in terms of productivity (10349 nuts per ha) next to Brazil (11574 nuts per ha), among the major coconut growing countries.

During the period from 2012-13 to 2015-16, the area under cultivation of coconut decreased from 21.37 lakh hectares to 20.96 lakh hectares. The decrease in area is mainly because of the rapid urbanization taken place especially in Kerala coupled with the effects of back to back cyclones hit coastal Andhra, Tamil Nadu and Odisha.

Coconut is a traditional crop in the major

coconut growing states of the country, which is cultivated over centuries. As coconut is grown as a homestead plant and cultivation is mainly taken up by the small and marginal farmers, the major part of the palms are retained even after their economic life. Hence about 20% of the palm population in India is estimated to be senile and unproductive. The massive Replanting & Rejuvenation programme is being taken up in the country after the successful implementation of the pilot projects in few areas of the country. The seedlings of new and improved varieties are also being planted under the area expansion programme assisted by the Central and State Governments in India. It is estimated that about 10 % of the palms in India are still in the juvenile phase.

Non-availability of sufficient quantity planting materials of new and improved high yielding varieties is one of the major obstacles faced by the farmers who are interested in coconut cultivation. Coconut is a smallholders' crop and the homestead/ fragmented nature of coconut cultivation makes it difficult to adopt modern scientific technologies and farm mechanization for higher income and reduced production costs. Dearth of skilled labourers for farm operations including harvesting, plant protection measures, crown cleaning, etc. are the reasons for lesser productivity. The natural calamities like droughts due to deficit monsoons, cyclones and climate change affect the coconut production and productivity. The incidence of pests and diseases in coconut is increasing due to the constraint that most of the plant protection operations are to be carried out the crown. This makes the process tiresome coupled with the old/ senile and uncared palms due to absentee landlordism service as breeding sites for the insects and pathogens. The wild fluctuation in coconut prices due to its seasonal nature and too many middlemen in the supply chain also are the reasons for reduced interests in coconut cultivation by the farmers which ultimately leads to reduced production and productivity.

II.1 Policies to Promote Farm Productivity and increase Farmer's Income:

In India, development programmes and policies in coconut are mainly carried out by Coconut Development Board under the Ministry of

Agriculture and Farmers Welfare. Production and distribution of quality planting materials, expansion of area under coconut especially in non-traditional States, promotion of adoption of integrated nutrient management, pest management and coconut based farming systems by establishing farmer participatory demonstration plots, replanting and rejuvenation of old and senile coconut gardens, Technology Mission on Coconut for promoting value addition, facilitating formation and handholding farmer producer organizations for promoting production, processing and marketing of coconut are the major policies adopted in India for promoting coconut sector. Formation of farmers' collectives in coconut sector is encouraged by the Government for aggregation, farm level processing and also to facilitate collective plant protection measures.

In India, development programmes in coconut is undertaken by the Board for replanting, new planting, rehabilitation for enhancing coconut production and productivity are listed below:

Replanting/new planting, rehabilitation and farm productivity programmes

India started Replanting and Rejuvenation (R&R) of traditional coconut gardens in the country. To begin with the programme was introduced in Kerala, the state with the longest history of coconut cultivation where 1/3rd of palm population was old, senile and disease advanced. Apart from the longest recorded history of coconut cultivation, the state is under the grip of a lethal disease called root wilt. Cutting and removing the disease advanced trees and giving management care to the existing palm population is the only strategy to manage the gardens. Therefore the R&R programme was implemented in the state from 2009 and is continuing. The main objective of the scheme is to enhance the productivity and production of coconut by removal of disease advanced, old and senile palms, replanting with quality seedlings and rejuvenating the remaining palms by giving compensation to farmers for cutting and removal, replanting and rejuvenation. The scheme has been extended to other traditional coconut growing states from 2016-17 onwards. So far more than 3.5 million palms have been cut and removed under the scheme and nearly 3.05 lakh ha was rejuvenated.

Production and distribution of planting material

Establishment of Demonstration cum Seed Production (DSP) Farms in different parts of the country for creating infrastructure facilities for production of quality planting materials besides

demonstrating and educating the scientific coconut cultivation and processing to various stake holders in those regions, establishment of Regional Coconut Nurseries for extending support to various participating states for strengthening the seedling production programme, distribution of hybrids/dwarf seedlings in Govt. sector, establishment of Nucleus Coconut Seed Gardens and coconut Nurseries in private sector are taken up under this programme. Last year nearly 20 lakh seedlings were produced and distributed under this scheme. 10 DSP farms have so far been established in different parts of the country.

Expansion of Area under Coconut

This programme is to extend adequate technical and financial support to the farmers to take up coconut cultivation on scientific lines in potential areas to attain a significant achievement in the future production potential. Financial and technical assistance is extended under the scheme for taking up new planting of coconut in potential areas.

Integrated Farming for Productivity Improvement programmes

The objective of the programme is to improve production and productivity of the coconut holdings through an integrated approach and thereby increasing the net income from unit holdings with the component programmes under Laying out of Demonstration Plots and establishing Organic Manure Units by providing incentives. Scientific integrated management practices including coconut based farming systems are promoted under the scheme by establishing farmer participatory demonstration plots in farmer's field.

Coconut Palm Insurance Scheme (CPIS)

The Coconut Palm Insurance Scheme intends

to provide insurance coverage to coconut crop. Under the scheme all healthy bearing palms in the age group from 4 to 60 years are eligible to get insurance coverage against natural perils leading to death or becoming unproductive. 50% of the insurance premium is borne by the Board and balance is shared between the State Govt. and farmers @ 25% each.

Publicity and Extension activities

The Board is disseminating information on various aspects of coconut cultivation and industry through various media and publications besides organizing training programmes to impart skills and knowledge to farmers, unemployed youths and rural women in various fields related to coconut. Board also regularly participate in exhibitions and fairs.

Technology Mission on Coconut

The Technology Mission on Coconut programme gives emphasis on the development of technologies for the management of insect pest and disease affected gardens and product diversification besides demonstration and promotion of these technologies for adoption. Under the Mission, research projects and clinical studies are sponsored through reputed institutions in the area of technology development and also to establish the medicinal and nutraceutical properties of coconut products especially coconut oil. Technical and financial support was given to establish 407 processing units with processing capacity of 2200 million nuts per year.

Performance of the Coconut Processing Industry

During the financial year 2016-17 export of coconut products (excluding coir items) was valued at Rs.20776.50 Million (US\$ 314.77 M) against Rs.14502.40 Million (US\$ 220 M) during the previous year, recording an increase of 43.26% in terms of value. Activated Carbon was the single largest item of export both in terms of quantity and value of export. Significant increase was recorded in the export of desiccated coconut, activated carbon and coconut oil. Activated carbon accounted for 39.23% of the total export of coconut products from India during 2016-17. Major coconut products such as coconut oil, desiccated coconut, copra, and coconut shell charcoal registered massive growth in export value.

As India started exporting coconut oil to Malaysia, Indonesia and Sri Lanka 392.70% increase in quantity was recorded i.e., from 6806.55 MT in 2015-16 to 33536.09 MT in 2016-17. It may be noted that prior to this, India was importing coconut oil from these countries. The export earnings are picking up with the surge in growth of industries like virgin coconut oil, activated carbon, shell charcoal etc. Indian products are moving to US, UK, Germany, Japan, France, Middle East, and African Countries. Advancement in technology development and the technical and financial support extended by India through the Coconut Development Board under the Technology

Mission programme for starting coconut based industries have been instrumental for this success. Added to these, the Board has been designated as Export Promotion Council (EPC) for various products other than coir based products from 1st April 2009 which also has contributed to a perceptible improvement in export which is depicted below:

Year	Export value	
	(In INR Million)	(In USD Million)
2009-10	4323.84	91.71
2010-11	5256.50	115.61
2011-12	8386.47	174.60
2012-13	10225.33	187.92
2013-14	11561.19	190.24
2014-15	13123.85	214.20
2015-16	14502.44	221.07
2016-17	20776.50	314.79

In the capacity of EPC, Board has so far given registration to 2346 exporters under its fold. This has enabled the Board to monitor the export scenario closely which is an indication of country's growth in the sector.

Coconut Product Utilization in the Country for 2017

It is estimated by the Board that 45% of the

production is used as raw coconuts for domestic consumption (70%) and for industries (30%) for production of desiccated coconut, virgin coconut oil, coconut milk/ cream, frozen grated/ dry coconut, etc. The rest 39% is converted to copra of which about 23% is consumed directly for various edible purposes. Coconut oil is extracted for edible, toiletry and other purposes from the balance 77% of the copra. Remaining 16% of the total coconut production in India is consumed as tender coconut.

Average FOB price of major coconut products

The time series price movement of coconut oil (domestic as well as international) for the last 13 years (from the year 2004 onwards) revealed that whenever there is rise in domestic coconut oil price, the international prices exerted a pull-down-force to make the prices integrated. This aspect very well validates the international trade theory on price integration of primary commodities in the trade liberalized regime. The crucial interpretation is that dependency on a single commodity like coconut oil will never provide the adequate margin to sustain for a longer period.

The FOB prices of major coconut products have shown a downward trend during 2017 compared to previous couple of years, except for desiccated coconut and charcoal. The copra prices have gone down to about 22 % i.e. US\$ 392.12 per MT during 2017 compared to US\$ 1817.01 prevailed during 2015. Decrease in the FOB prices ranging from 15 to 41 % were observed for activated carbon, fresh coconut, raw coir fibre, and coconut oil. Since there is no separate HS code for coconut milk/ cream/ powder, coconut water and coconut sugar, there is no possibility of getting precise data on its export from India

Price trends and factors affecting the price of coconut products

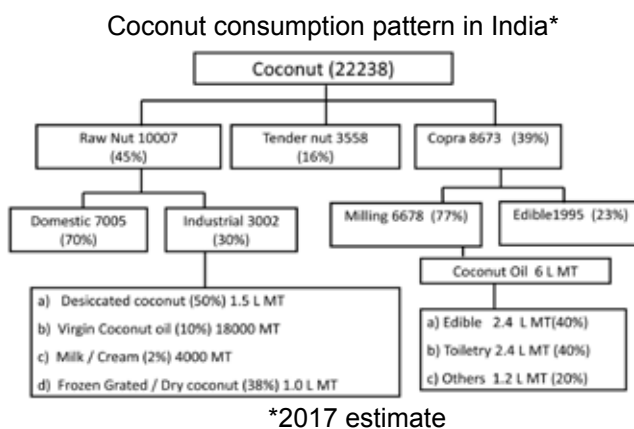
Price of coconut oil had shown a decreasing trend during the year 2012-13. Price started improving from mid of 2013 and same trend continued during 2014. In the year 2014, the monthly average price of coconut oil which opened at Rs.10982/- per quintal in January at Kochi market expressed a bullish trend and reached Rs.16477/- per quintal in August. Thereafter the price expressed a slight declining trend. In 2015 the monthly average price expressed mixed trend till August and thereafter expressed a declining trend and closed at Rs.10118/- per quintal and the same trend continued till July 2016. Thereafter price showed

an upward trend. The price started rising up from the month of May, 2017 and at present is ruling at the highest level of Rs.16700/- per quintal in September at Kochi Market.

The price of milling copra was below the MSP of Rs.5100 per quintal in all the three major markets in Kerala throughout the year 2012. The year 2013 started with a mixed trend in the prices of milling copra and the prices remained below MSP of Rs. 5250/- per quintal till the middle of the year. The prices improved from mid of 2013 and same trend continued during 2014. In the year 2014, the monthly average price of milling copra which opened at Rs.7911/- per quintal in January at Kochi market expressed a bullish trend and reached Rs.11394/- per quintal in August. Thereafter the price expressed a slight declining trend and closed at Rs.8957/- with a net gain of Rs. 1046/- per quintal. In 2015, the monthly average price expressed a mixed trend till June, thereafter expressed a declining trend and closed at Rs.6562. In January 2016, the monthly average price recorded at Rs.6040 per quintal, expressed a mixed trend till July and thereafter expressed an upward trend and closed at Rs.7,356 per quintal. In 2017, the monthly average price opened at Rs.8,200 per quintal in January showed an upward trend and ruled at the highest level of Rs.11700/- per quintal in September at Kochi Market.

Coconut Processing Plants and their Capacities for 2015, 2016 and 2017

During the year 2015-16, 61 coconut processing units were assisted by the Coconut Development Board for producing copra, coconut oil, flavoured coconut juice, virgin coconut oil, packaged tender coconut water, Neera and Neera based products, shell charcoal, activated carbon, etc. About 30 units were assisted during 2016-17. Board has sanctioned



the establishment of 22 processing units in the country during 2017-18. The coconut shell based activated carbon units are run with about 80 % of the installed capacity to produce 9300 MT activated carbon.

Update of Recently Adopted National Quality Standards of Coconut Products

The Technology Development Centre of CDB in Kerala is engaged in the development and demonstration of technologies for product diversification and by-product utilization of coconut.

The centre is devoted to product development, microbial analysis of coconut based products, apart from skill development programmes to interested entrepreneurs and self help groups for acquiring technologies on post harvest coconut processing and process demonstration. The Institute received the recognition of NABL. Many value added and novel products were developed by the institute during the last year and the institute has now been designated as CDB Institute of Technology (CIT).

V. Marketing and Product Promotion

Major Market Destinations of Traditional Coconut Products

The UAE, China, Iran, Oman and Saudi Arabia are the major markets for fresh coconuts. Copra attracts a very good demand from the countries like Bangladesh, Nepal, Iran, Vietnam and Hong Kong. Coconut oil enjoys a good market in Indonesia, Malaysia, Srilanka, Ireland and Mauritius. USA, Korea, US, Russia and Netherlands area the major buyers of activated carbon.

Major Market Destinations of Non-Traditional Coconut Products

As far as the non-traditional coconut products are concerned, VCO has a good demand in Brazil, France, USA, UAE, Oman, Mexico, Qatar and the United Kingdom. Countries like UAE, Kuwait, Oman, USA, Saudi Arabia, Qatar, Canada and UK have good markets for the products like coconut water and coconut milk powder.

Government Policies Related to Coconut Trade and Market

The Government of India is providing positive environment for the trade of coconut products and also ensure that farmers are not exploited by traders by declaring Minimum Support Price (MSP) for coconut and copra. The MSP for copra has been introduced since the year 1986 for ensuring a remunerative price to coconut farmers for their products. It is a policy decision of the Government of India to announce the MSP for milling as well as ball copra for every season with the guarantee to purchase the copra at the pre-announced price, in the event of a fall in market price and thereby ensuring reasonable price for the produce of the



coconut farmers. The present MSP for coconut, ball/ edible copra and milling copra are Rs. 17600/- (US\$ 274) per MT, Rs. 67,850 (US\$ 1054) per MT and Rs. 65,000/- (US\$ 1010) per MT, respectively.

The Government of India implemented Goods and Services Tax (GST) on 1st July 2017 with the aim to improve ease of doing business in the country. GST was implemented by amalgamating large number of Central and State taxes into a single tax which would mitigate cascading or double taxation in a major way and paves way for a common national market. GST, being a simple tax regime, is expected to reduce the complications in doing business and improve trade. The GST applied on various coconut products ranges from 0 to 28 % with the slabs of 5, 12 and 18% . Coconut hookah and hair cream are the only two products attract the maximum of 28 % GST.

In order to discourage import and protect domestic industry, import tariff is introduced by the Government of India. The Basic Customs Duty for various coconut products are in the range between 10 % and 150 %. Coconut milk powder and coconut

water powder only attract 150 % import duty. Coconut oil import draws an import duty of 12.50 % and virgin coconut oil draws 20%. The other vegetable edible oils like soyabean oil, groundnut oil, olive oil, palm oil, mustard oil, sunflower oil, etc. also attract duties ranging from 12.50 % to 25 % on import similar to duties on import of coconut oil.

Coconut and coconut products have very good market potential within as well as outside the country. Towards expanding the market for Indian coconut products across the globe, the Board is extending support to the industry through the programmes: Support for sales outlets/ kiosks for value added coconut products, facilitating participation in domestic exhibitions/ trade fairs and buyer-seller meets in metropolitan cities within the country, encouraging coconut product exporters with award for export excellence, overseas and domestic industrial exposure visits to prosperous manufacturers, organising workshops/ seminars for entrepreneurs and exporters etc.

Coconut Research and Development Updates

India was lagging behind in technology development for product diversification till the last two decades. Introduction of Technology Mission has given momentum to this area and now India possesses many technologies in value addition. Acceleration to the activities of CDB Institute of Technology, further quickened the product development. In the world for the first time technology for processing and packing of neera and various downstream products like neera sugar, jaggery, honey etc have been developed. Food products like sweet/spicy chips, sweet chunks, chocolate, cookies, burfi, lemonade, flavoured juice, ice cream and milk spread are also the other very new additions of CIT's contribution in the product basket.

Product basket from coconut - Value added coconut products – Existing and new



Water based

Packed Tender Coconut Water, Coconut Vinegar, Nata de coco etc.



Inflorescence sap (Neera) based

Neera beverage and Neera based value added products etc.

Shell based

Shell Powder, Shell Charcoal, Activated Carbon, etc.



Kernel based

Coconut Oil, Virgin Coconut Oil, Desiccated Coconut, Ball Copra, Coconut Cream, Coconut Milk Powder, etc.

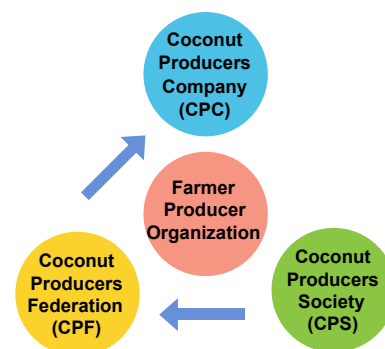


Three tier Farmer Producer Organization (FPO) in coconut sector.

CDB started a novel extension approach to organize farmers by formation of three tier Farmers Producers Organization (FPO) with Coconut Producers Societies (CPS) at primary level and integrate them to form Coconut Producers Federation (CPF) at intermediate level and Coconut Producer Company (CPC) at apex level. The Company establish processing unit for production of value added products from coconut procured from the member farmers. There are at present 9439 CPSs, 733 CPFs and 67 CPCs functioning in the country.

5.2. Skill Development Training Programmes (Friends of Coconut tree (FoCT))

Acute shortage of palm climbers to harvest and adopt plant protection measures is one of the problems faced by coconut growers. With a view to tackle this problem, the Board is conducting skill development programme from 2011-12 onwards, to train unemployed youths in developing special skills and confidence in coconut climbing and plant protection activities for the benefit of coconut farming community. The skill fetches the youth handsome income for their decent living and help to make available sufficient manpower to society in coconut harvesting and other plant protection activities.



Establishment of International Centre of Excellence in coconut

In the 51st APCC session during (02-05 February 2015 at Kochi) the Government of India proposed the establishment of International Centre of Excellence in Coconut and offered to be the host nation providing necessary land, infrastructure and facilities.

A Joint meeting of APCC and CDB tentatively fixed the objectives of Centre. It will facilitate large scale capacity building for member countries, will conduct “Field level farmer based research” and research partners of the centre shall be CPCRI, KAU, TNAU and SAUs. The centre shall take up the mandate of propagating use of value added coconut products.

The Centre will be able to store, develop & share the vast wealth of knowledge in coconut sector worldwide for immediate benefit of the member countries and coconut stakeholders globally. The Centre will be able to take a lead role in technological advancement in expansion and conservation of genetic base of coconut, integrated pest management, integration of coconut based farming system and coordinating conclusive clinical trials on health benefits and medicinal properties of coconut.

Other Issues/Problems/Recommendations

Indian coconut sector has to improve in many areas in spite of the unprecedented progress achieved in selected sectors. There are many issues to be addressed and solutions to be arrived at. Inadequate availability of quality planting material in tune with the increasing demand, low pace of value addition, low level of productivity than the potential, low pace of expansion of crop and low level of Replanting and Rejuvenation of old plantations, non availability of disease tolerant and short stature high yielding varieties are issues that still need solution. Against the annual requirement of 10 million seedlings, the present supply is only 3.5 million seedlings. Considerable area suitable for coconut is available in traditional and non-traditional areas in the country which need to be utilized for expanding the crop. Through convergence of various programmes and bridging the gap in existing schemes, India will try to make coconut a more remunerative crop by enlarging the scale and size of operations and reducing production costs giving more thrust on irrigation, drought management, and soil and moisture conservation. Restructuring of planting population giving more stress on hybrids and dwarf and more diversion of production to value addition, improvement in quality standards matching with international standards, adoption of new marketing strategy for tapping domestic and international markets and widening the skill development in all essential areas of production and processing will be other areas of priority. Indian Coconut sector is striving hard to grow further for the benefit of millions of farming community. The country is aiming at sustaining the premier status enjoyed at global level in production and productivity and also in the process of gaining the prime position in export front too. India look forward collaboration and involvement of APCC, its member countries and other international organizations in collaborative research especially coconut oil, development of new varieties resistant to biotic stress, exchange of technologies, joint ventures in coconut sector etc.

paper presented during 53rd APCC session during 23-29 October 2017, at Tarawa, Kiribati

Mixed cropping of Pepper in coconut gardens

Successful experiences of a farmer

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Coconut in India is predominantly cultivated in small and marginal holdings. Monocropping of coconut in such holdings does not fetch sufficient income to the farm family to meet their diverse needs. Besides, basic resources like soil, sunlight and aerial environment are not being fully utilized in a coconut garden when sole cropping of coconut is adopted. It has been amply demonstrated that mixed cropping in coconut garden i.e., growing of perennial plant species in the interspaces of coconut, enhances the income and productivity from coconut farming apart from utilizing the available natural resources effectively. Adoption of mixed cropping practices in coconut gardens assumes much significance in the present day context of price fall and price fluctuation of coconut.

A number of perennials can be grown in

association with coconut. The success of mixed cropping primarily depends on the availability of sunlight and level of adoption of crop management practices. In the third phase of life of coconut i.e. from 20 years after planting onwards, any form of mixed cropping with perennials is possible. By this time, the coconut palm would have attained sufficient height and about 55% of light is available below the palm canopy to benefit the component crops in the mixed cropping system. About 85 % of the coconut roots are concentrated in the soil upto a depth of 30 to 120 cm but the lateral root spread is limited to two metres from the bole, i.e., only 25% of the available land is being utilized by coconut roots. Hence, in this growth phase of coconut, perennial crops can be grown along with coconut for effectively utilizing the basic resources of soil, water and sunlight.

Availability of irrigation facility is important

for successful mixed cropping in coconut garden. Similarly, adoption of crop management practices recommended for coconut and component crops, especially integrated nutrient management practices, is to be ensured and competition between coconut and component crops should be avoided; otherwise yield of coconut will be adversely affected. A radius of 2 m has to be kept free around each palm to avoid any competition except for pepper which has not been found to affect the yield of coconut. During the initial years, banana can be raised in the space available which will provide shade for the mixed crop seedlings and also give additional returns. Depending on the availability of interspaces, other short duration crops such as pineapple, elephant foot yam, ginger etc. can also be raised along with the perennials in the initial years. Crop residues available in the mixed cropping system can be used for mulching the basin of coconut palms and mixed crops. Adoption of this kind of on farm recycling of bio mass enhances soil health in the coconut based mixed cropping system.

Mixed cropping of pepper in coconut garden – A success story

Pepper is an important spice crop that can be grown as a mixed crop in coconut gardens in the West Coast region. Studies conducted by ICAR-CPCRI and other research institutions have unambiguously proved the technical feasibility and economic viability of mixed cropping of pepper compared to the monocropping of coconut. Many farmers also have demonstrated that pepper can be profitably grown as a mixed crop in coconut garden. The successful

experiences of a farmer in mixed cropping of pepper in coconut garden is narrated as below:

Mr. Kunhambu Nair is a 68 year old farmer and his small farm of 2.5 acres is located in Periya village of Kasaragod district of Kerala. He took up farming at a very young age of 17 years. He belongs to the category of farmers who is a rarity now a days – a full time farmer who solely depends on farming for his livelihood. Major crops cultivated in his farm are coconut and arecanut and he successfully maintains black pepper as a mixed crop along with these principal crops. Banana (Nendran variety) and vegetables are also cultivated in his farm and also

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Pepper is an important spice crop that can be grown as a mixed crop in coconut gardens in the West Coast region.
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in leased land in the adjacent locality. His farm is located in an undulating sloppy terrain and the upper portion of the farm is covered by coconut maintained in an extent of 70 cents and mixed cropping of pepper is adopted in the entire 70 cents of land along with coconut. Arecanut is grown in the lower reach in 50 cents out of which pepper is mixed cropped in 20 cents of land along with arecanut leaving the remaining 30 cents for monocropping of arecanut.

The coconut palms of West Coast Tall variety numbering 50 are now 15 years old. A wider spacing of 9 m has been given for coconut and the pepper has been planted at 4 m in the interspaces in between the rows of coconut leaving about 3 m from coconut basin. He has accommodated 40 pepper vines in the interspaces. For both the crops, he has given wider spacing than the recommended spacing. Mr. Kunhambu Nair says wider spacing avoids competition between crops for water and nutrients and also there is scope for cultivating short duration crops like banana and vegetables within the system, apart from coconut and pepper, if spacing is wider.

Stem cuttings of *Erythrina indica* (Murikku), as the standard tree, were collected from a nearby locality and planted in pits of 50 cm × 50 cm × 50 cm size filled with cow dung and top soil. The planting was done at a spacing of 4 m. The black pepper vines were trailed on the standards after three years when they attained sufficient height. With the onset of monsoon, pits of 50 cm x 50 cm x 50 cm were taken at a distance of 30 cm away from the base, on the

north side of *Erythrina*, the supporting tree to plant pepper cuttings. The pits were filled with a mixture of top soil, farm yard manure @ 5 kg/pit and 150 g rock phosphate. Neem cake @ 1 kg enriched with *Trichoderma harzianum* @ 50 g was also added at the time of planting. Rooted cuttings of Panniyur-1 pepper variety were used for planting. Though Panniyur -1 variety generally performs well



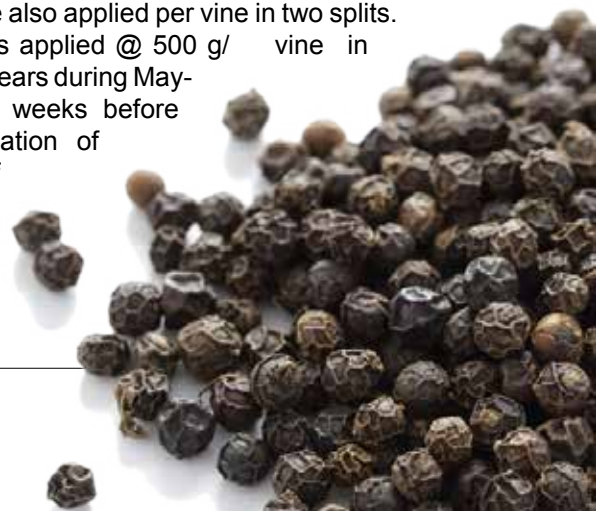
Thus Mr. Kunhambu Nair got a substantial amount of additional income from these subsidiary crops raised during the initial three years. Apart from the monetary benefits, shade for pepper vines was assured and also lot of biomass obtained as crop wastes was used for recycling within the coconut based cropping system. As the pepper vines started flowering by third year, he discontinued

the intercropping of banana and vegetables thereafter. He adopts soil test based nutrient management practices for coconut and pepper which according to him holds the key for higher yield from coconut and pepper. Organic manure application is important for improving soil fertility as well as enhancing water holding capacity of the laterite soil in his farm. He regularly applies goat manure @ 25 -30 kg per coconut palm and also neem cake @ 5kg per palm. Besides, he used to apply fish manure @ 2 kg / palm in alternate years. Green leaves collected from his farm and adjacent localities are also applied on a regular basis. Organic manures are applied towards the end of South West monsoon with the cessation of heavy rains. Muriate of Potash is given @ 2 kg per palm in three equal splits (May-June, September and January). Since boron deficiency is indicated in the soil test results, he is applying 100 g borax to every coconut palm. Dolomite is applied @ 1 kg per palm which will correct the acidity in the soil and also take care of magnesium requirement of coconut palms. Integrated nutrient management practices are adopted for pepper vines also. Organic manures viz., goat manure and cowdung @ 4 kg each per vine are being regularly applied besides 1 kg neem cake. About 100 g urea and 400 g Muriate of Potash are also applied per vine in two splits. Dolomite is applied @ 500 g/ vine in alternate years during May-June, two weeks before the application of first split of

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chemical fertilizers. Micronutrient mixture is diluted @ 5 g per litre water to spray pepper vines twice a year, at the start of flowering and after one month.

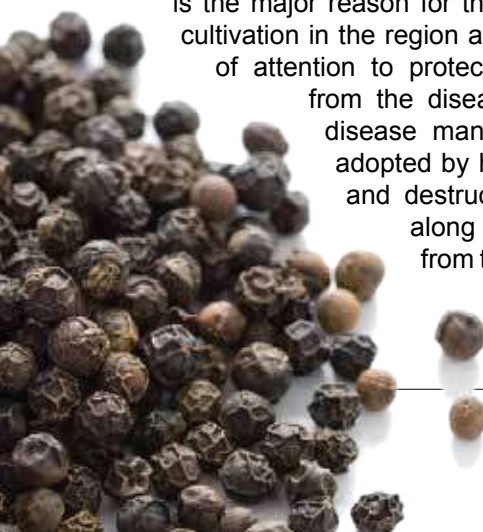
Since sufficient water is available from the bore well in his garden, he is able to provide irrigation to coconut palms once in four days @ 200-250 litres per palm per irrigation during the period from December to May. Basin irrigation method is adopted using hose pipes. Pepper vines are also provided irrigation during the summer period from March to May. Pepper vines are irrigated at the basin through hose and each vine gets about 40-50 litres of water.

Except for the incidence of rhinoceros beetle and eriophyid mite, pest and disease problems are very less for the coconut palms in his garden. Crown cleaning of palms is taken up regularly and rhinoceros beetles are collected and destroyed using beetle hooks. According to Mr. Nair, the most important aspect of successful mixed cropping of pepper in coconut garden is the integrated management of foot rot (quick wilt) disease of pepper. He is quite aware that loss of vines due to quick wilt disease

is the major reason for the decline in pepper cultivation in the region and thus he gives lot of attention to protect the pepper vines from the disease. The integrated disease management strategies adopted by him include removal and destruction of dead vines along with root system from the garden to reduce the build up of inoculums of the

fungus *Phytophthora capsici* causing the disease, avoiding injury to the root system of pepper vines due to cultural practices such as digging, pruning off the freshly emerging runner shoots so that they are not allowed to trail on the ground, pruning of the branches of *Erythrina* at the onset of monsoon to avoid build up of humidity and for better penetration of sunlight, drenching of pepper vines at a radius of 50 cm with copper oxychloride @ 5-10 litres/vine and foliar spray with 1% Bordeaux mixture after the receipt of few summer showers during May, and during August-September and a third round of drenching during October if the monsoon is prolonged. Mr. Nair also says that if infection is observed on pepper leaves even after spraying with 1% Bordeaux mixture, foliar spray with potassium phosphonate is also done.

During the first harvest i.e. three years after planting, he was able to harvest about 100 kg of pepper. The yield of pepper gradually increased and stabilized by 6th year. Now he is harvesting 5-6 kg pepper per vine per year which is quite an attractive yield compared to the state average of less than one kg per vine. In the mixed cropping system, he is able to realize high productivity in coconut also. Average yield of coconut palms in the system is 150 nuts per palm per year. As a fulltime farmer he is able to use family labour to a great extent. Hired labour also is used for some of the farm activities such as harvesting of coconut and pepper, weeding, manuring and plant protection. According to him, pepper mixed cropping in coconut garden has been highly beneficial during the tough times of price fluctuation experienced for both pepper and coconut. Few years back pepper price recorded





“Adoption of inter/mixed cropping to effectively utilize the basic natural resources of sunlight, soil and water is very important for realizing higher returns from farming in small holdings.”

all-time high when the coconut price situation was rather grim. Now the pepper price has come down but there is an encouraging trend observed in price of coconut. During last year he was able to realize a net income of about Rs. 1.6 lakhs from the coconut based mixed cropping system maintained in 70 cents of land.

The key to his success in farming, according to Mr. Kunhambu Nair, is the scientific management of soil health and plant health. Adoption of inter/mixed cropping to effectively utilize the basic natural resources of sunlight, soil and water is very important for realizing higher returns from farming in small holdings. Apart from managing the coconut and arecanut based cropping system, he also regularly grows nendran banana and vegetables like bitter gourd, in leased land. Integrated Pest Management

practices including use of tapioca leaves based bio-pesticides ‘Nanma’ and ‘Menma’ against banana pseudo stem weevil were successfully demonstrated in his Nendran banana plot with the support from Krishi Vigyan Kendra (KVK) Kasaragod. During this year, he is cultivating vegetables (600 pits of bitter gourd, 300 pits each of ridge gourd and snake gourd) in two acres of leased land along with six other members of a farmer Self Help Group in his locality. His enterprising nature has enabled him to enhance his income through another activity i.e. production and sales of planting material of *Erythrina indica*, the standard tree for pepper.

He is very keen to share his experiences and knowledge in farming to other farmers. His achievements in farming, especially mixed cropping of pepper and high density planting of nendran banana, have been highlighted through media including farm columns in newspapers and radio programmes broadcasted through All India Radio, Kannur. He maintains regular contact with research institutions such as Central Plantation Crops Research Institute, Kasaragod and College of Agriculture, Padannakkad and participates in the scientist-farmer interface programmes whenever conducted in these institutions.

The excellent stand of pepper vines as mixed crop along with high yielding coconut and arecanut palms easily attracts the attention of any visitor to Mr. Kunhambu Nair’s farm. And deservedly, he has been awarded by Department of Agriculture for his achievements in farming. He was selected as the best pepper grower of Kasaragod district in the years 2009 and 2013.

Mr. Kunhambu Nair can be contacted in his mobile phone number 9947634224 ■



Nutritional and health aspects of coconut oil

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Never before in the history of man is it so important to emphasize the value of Lauric Oils. The medium-chain fats in coconut oil are similar to fats in mother's milk and have similar nutraceutical effects. These health effects were recognized centuries ago by Ayurveda. The knowledge of the aborigines of Nicobar Islands and the tribal population of other parts of India on the medicinal application of coconut palm products is extensive. They depended on these products for treating numerous ailments.

According to the Ayurvedic classics, coconut oil (CNO) nourishes the body and increases strength. The oil was also valued for its antimicrobial properties. The use of the oil medicated with herbs is widespread among the people of India. Different preparations of CNO promote luxurious hair growth and protect the skin from bacterial, protozoal and viral infections. Fresh lauric oil is wholesome to heart.

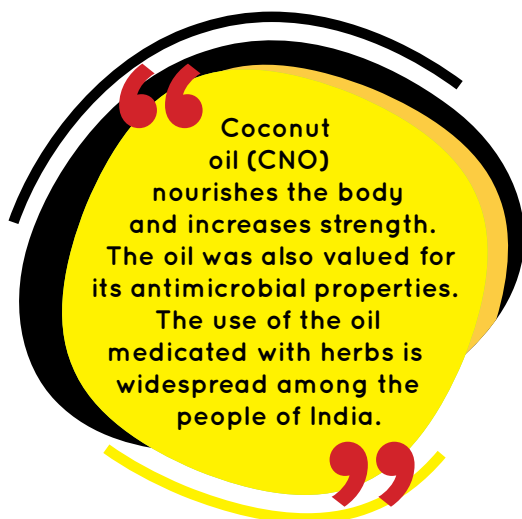
In the past five decades misinformation and disinformation provided by certain politically biased agricultural groups and repeated in professional and lay press have led people to believe that all saturated

fats are unhealthy. Little attention is focused on the fact that saturated fatty acids are not a single family of fats but comprises of three subgroups; short- (C2-C6), medium- (C8-C12) and long- (C14-C24) chain fatty acids. The medium chain fats are found exclusively in Lauric Oils.

If we need to understand the health benefits of medium chain saturated fats, it is necessary to specify the effects of each saturated subgroup. While it has been known for decades that subgroups existed for unsaturated fats i.e. monounsaturated fats (omega-9) and polyunsaturated oils ((omega-6 (vegetable oils) and omega-3 (fish oils))), little recognition is given even today to subgroups of saturated fats. Each fat subgroup has different metabolic, biological and pharmacological functions.

Medium vs. Long Chain Saturated Triglycerides

It needs to be emphasized that both the composition and stereo-specific location of a saturated fatty acid on the glycerol structure is critical



to its biological effects. The acyl groups located at the sn-1 and sn-3 position are absorbed as free fatty acids while the acyl group in the sn-2 position is absorbed as a monoglyceride. Short and medium-chain fatty acids (MCFA) are solubilized in the aqueous phase of the intestinal contents, where they are absorbed, bound to albumin and transported directly to the liver via the portal vein. Long-chain FA's however are transported via lymphatic and systemic circulation as chylomicrons before finally ending up in the liver. However the location of long chain fatty acids (LCFA) on the glycerol molecule can also influence their metabolic destiny. Free palmitic and stearic acid in the sn1 and sn3 position of glycerol have low coefficients of absorption because of melting points above body temperature and their ability to form calcium salts. Therefore, fats that have long-chain saturated fatty acids located at the sn-1 and sn-3 positions of triglycerols can exhibit different absorption patterns and metabolic effects compared to fats with palmitic or stearic acids found at the sn-2 position, which are absorbed more efficiently as monoglycerides.

Although long-chain fats have a kilocalorie values of 9.0 per gram, medium-chain triglycerides (MCT) fats have ~10% less (8.3 kilocalorie/gram). MCT have been shown easier to digest and are absorbed and oxidized faster than LCT fats. MCFA are transported directly to the liver and enter mitochondria without the benefit of carnitine. Compared to long-chain fats, MCT's are deposited less into adipose tissue, decrease protein catabolism in hyper-catabolic

states, raise thyroid function and do not form esters with cholesterol.

Medium-chain saturated fats fail to raise cholesterol levels when supplied with sufficient polyunsaturated fatty acids to avoid EFA deficiency. Studies showing harmful effects of so-called "tropical oils" were generally carried out in the absence of essential fatty acids in the diet.

The following will document several examples of medium-chain saturated fatty acid derivatives as nutraceuticals:

Dental Caries and Cancer

Numerous papers from our laboratory and others have shown the positive health consequence of MCFA and their monoglyceride (MCMG) derivatives on dental caries formation in experimental animals. Because of their antimicrobial action reductions in dental caries as high as 80% have been reported. MCT as opposed to polyunsaturated fats have no growth- promoting effects in tumor-bearing animals. In 1987 a 50-year review showed the anticancer effects of coconut oil. In chemically induced cancers of the colon and breast, coconut oil was by far more protective than unsaturated oils. For example: 32% of corn oil users got colon cancer whereas only 3% of coconut oil eaters got the cancer. Many studies since the early 1920's have shown an association between consumption of unsaturated oils and the incidence of cancer. Animals fed unsaturated oils developed more tumors. The known immune-suppressive effects of unsaturated oils can explain the adverse increase in cancer.

Details on these positive health effects of saturated lipids in dental and cancer research can be found in Pharmacological Effect of Lipids, Volumes 1, 2, and 3, edited by J. J. Kabara and published by AOCs Press.

Benign Prostatic Hyperplasia (BPH)

It is common for the prostate gland to become enlarged as a man ages. Doctors call the condition benign prostatic hyperplasia (BPH), or benign prostatic hypertrophy. More than half of men in their sixties and as many as 90 percent in their seventies and eighties have some symptoms of BPH. While the exact cause of BPH is not known, one theory focuses on dihydrotestosterone (DHT), a substance derived from testosterone in the prostate. This steroid may help control the increase in prostate size. Older men continue to produce and accumulate levels of DHT in the prostate even when there is a drop in blood testosterone level. This accumulation of DHT

can encourage the growth of cells in the prostate. Dihydrotestosterone is produced from testosterone by the action of the enzyme 5-alpha-reductase. Compounds that inhibit this enzyme can be expected to have a beneficial effect on BPH. The fuzzy rat has been used to examine the effects of inhibitors of human steroid 5-alpha-reductase isozymes. Finasteride, a prescription drug, induces a moderate degree of lobular and ductal reduction. The weight of the prostatic lobes was reduced significantly in rats treated with finasteride. Hence compounds (finasteride) that inhibit 5-alpha-reductase are useful in the treatment of BPH.

Nutraceutical treatment of BPH with MCMG/MCT

One of the more common plant lipid extracts used for treating BPH is obtained from the Saw Palmetto (*Serenoa repens*). The benefits of Saw Palmetto can be traced back to the early 1700's, when the aborigines of the Florida peninsula depended largely upon the berries to treat atrophy of the testes, impotence, and inflammation of the prostate. Therefore, it is of interest to determine whether this phytopharmakon has any influence on the androgen metabolism in the human prostate. It was found that crude lipid extracts of the berries inhibited 5-alpha-reductase activity in the epithelium and stroma of human BPH. The mean inhibition was 29% and 45%, respectively. This inhibitory effect was mainly due to the saponifiable subfractions where the mean 5-alpha-reductase inhibition of 39% and 38% in epithelium and stroma, respectively was found. The inhibition was dose dependent and noncompetitive. The nonsaponifiable subfraction, consisting mainly of phytosterols, showed a mean inhibition of 5-alpha-reductase in the epithelium and stroma of 15% and 10%, respectively. Finally, the hydrophilic subfraction, containing carbohydrates, amino acids, and polysaccharides showed no inhibitory effect. Thus, this inhibition is mainly due to the saponifiable subfraction (FA's).

Previous studies however have shown that the biological effects of monoesters of fatty acids are always more active than the non-esterified fatty acid. Further confirmation of this was found in the work of Shimada, Tyler and McLaughlin (1997). Brine shrimp lethality-directed fractionations of the 95% EtOH extract of the powdered dried berries of *S. repens* without saponification was carried out. This led to the isolation of 2 monoacylglycerides, 1-monolaurin and 1- monomyristin. Both compounds showed moderate biological activities in the brine shrimp lethality test (BST) and against renal (A-498) and pancreatic (PACA-2) human tumor cells; borderline cytotoxicity was exhibited against human prostatic (PC-3) cells.

As the search for the ideal antiandrogen continues, the lipidic extract of the Saw Palmetto containing medium-chain monoglycerides appears to be one therapeutic treatment for benign prostatic hyperplasia, hirsutism and other similar problems. Since tropical oils and MCT's can be converted to these biologically active FAs and/or MCM's in vivo, a dietary (nutraceutical) approach to healing BPH may be available.

Nutraceutical Treatment for Ulcers with MCT

Evidence from 1982 has focused on what constitutes mucosal resistance and how it can be disrupted to produce, in the presence of gastric acid, ulcers. Depletion of endogenous prostaglandins and the presence of *Helicobacter pylori* have emerged as seven prominent evidences to support the role of this microorganism in this clinical situation. Recent epidemiological data indicate an association between *H. pylori* infection and the subsequent development of gastric carcinoma.

Antibacterial regimens directed against the bacterium have provided a permanent cure for these chronic disorders. Most patients with ulcers can be cured by a one-week course of anti-*H. pylori* therapy, thereby removing the need for long-term acid inhibitory therapy. The clearest indication for

Table 1: Bioactivities of F005*, 1 and 2

Fraction	BSTa	A-498b	PC-3c	PACA-2d	PC-3c
F005 (MeOH)	79.9	31.5	35.7	29.9	
Monolaurin(1)	79.2	3.77		23.28	2.33 Monomyristin(2)
	53.3	3.58	8.84	1.87	
Adriamycine e	0.01		0.01		0.04

*Alcoholic extract of the Saw Palmetto

●Brine shrimp lethality test; LC50 values are in µg/mL. ●b Kidney carcinoma. ●c Prostate adenocarcinoma. ● Pancreas carcinoma.
● Positive control standard for MTT test; all cytotoxicities are ED50 values in ug/m L.

H. pylori eradication is in the treatment of *H. pylori* positive duodenal and gastric ulcer since eradication of the infection prevents ulcer relapse, effectively curing the disease. However, evidence has been presented that treatment of *H. pylori* like other bacteria produces resistant organisms.

The search for the ideal antimicrobial treatment regimen, which will combine high efficiency, safety and patient acceptability, continues.

Our laboratory was the first in the modern (1970) era to reintroduce the value of natural, medium chain lipids for inactivating microorganisms. A number of free fatty acids (FFA) and their corresponding esters were shown to have potent antibacterial and antiviral activities. One example can be found in table 2.

Prior to our work earlier reports only indicated, that such bactericidal activity was associated with FFA. Our research indicated that the monoglycerides (MG) but not di- or tri-glycerides were more active than the non-esterified fatty acid. The greatest antibacterial activity was with the medium chain saturated fatty acid having 8-12 carbon atoms. The mechanism by which MG and FFA exert their antibacterial activity has been defined. The disruption of the cell membrane permeability barrier and inhibition of amino acid uptake is the best explanation for their activity.



H. (Campylobacter) pylori was found to be sensitive to the toxic effects of an unsaturated fatty acid (arachidonic acid, linoleic and oleic acids). The effect was probably due to the formation of peroxides since exogenous catalase added to basal media enhances the growth of *H. pylori* by preventing the formation of toxic peroxidation products from long-chain unsaturated fatty acids.

More recent studies have shown greater inhibition by saturated lipids to the growth of *Helicobacter* sp, a gram-negative organism. Incubation of *H. pylori* with saturated MG ranging in carbon chain length from C10:0 to C14:0, at 1 mM caused a 4- log-unit or greater reduction in the number of viable bacteria after exposure for 1 h. Lower levels of bactericidal activity were observed with C9:0, C15:0, and C16:0 MGs. In contrast, the free lauric acid (C12:0) was the only medium-chain saturated FA with bactericidal activity against *H. pylori*. The MG and FFA were bactericidal after incubation for as little as 15 min at neutral or acidic pHs.

Resistance to antimicrobial agents remains an important clinical problem for *H. pylori* treatment strategies. Therefore it was of interest to measure and compare the frequencies of spontaneous development of resistance to several MG and antibiotics among different laboratory strains of *H. pylori*. The frequency of development of resistance by, *H. pylori* was higher for metronidazole and tetracycline than medium-chain MGs. The failure to show that microorganisms become resistant to medium-chain saturated lipids over time is critically important to their wide spread use. Recent papers have shown that resistant organisms have evolved from the use of a popular germicide, Triclosan.

Collectively, the data demonstrate that *H. pylori* is rapidly inactivated by medium-chain lauric acid

Table 2: Comparison of Antifungal Activities of Fatty Acid Monoesters With Some Commonly Used Preservatives

Minimum inhibitory concentration(µg/ml)			
Food additive	<i>Aspergillus niger</i>	<i>Candida utilis</i>	<i>Saccharomyces cerevisiae</i>
Monocaprin	123	123	123
Monolaurin	137	69	137
Butyl-p-hydroxy benzoate 200	200	200	200
Sodium lauryl sulfate	100	400	100
Sorbic acid	1000	1000	1000
Dehydroacetic acid	100	200	200

esters. These saturated lipid derivatives exhibit a relatively low frequency of spontaneous development of resistance to the bactericidal activity of MG.

Medium-Chain Monolaurin versus Viruses

When coconut oil is consumed, the body makes the disease fighting monolaurin, the monoglyceride of lauric acid. Kabara and co-workers have shown as early as 1966 that lipophilic compounds had an adverse effect on lipid coated viruses. Later it was found that simple lipids could inactivate bacteria, yeast, fungi and enveloped viruses by disrupting the lipid membranes of the organisms. The antimicrobial effects of added and endogenous fatty acids and monoglycerides are additive and total concentration is critical 9 for inactivating viruses. Among the saturated fatty acids, lauric acid has the maximum antiviral activity.

Kabara, although a professor emeritus from Michigan State University, continues to promote the practical aspects and the potential benefit of nutritional support regimen for individuals infected with genital herpes and other herpetic viral problems using medium chain lipids. While anecdotal stories have suggested that coconut oil or monolaurin (Lauricidin®) have positive effects in AIDS patients, controlled studies have been lacking or of short duration.

In one study by Wanke et al however HIV patients with chronic diarrhea were randomly assigned to one of two complete nutritional products with either medium- or long-chain triglycerides fat exclusively for 12 days. All patients responded to intervention with both nutritional products overall with 45% fewer stools, decreased stool fat and weight, and a significant increase in urine nitrogen. The group that received the MCT product demonstrated significantly decreased stool number (mean 4 to 2.5), stool fat (mean 14 to 5.4 g), and stool weight (mean 428 to 262 g) compared with baseline ($P < 0.01$ for all). HIV patients with diarrhea, regardless of etiology, and documented fat malabsorption benefited symptomatically from a diet composed of an MCT-based liquid supplement. Unfortunately this study was of short duration and effects on viral load or other blood clinical markers were not examined.

Kabara with the cooperation of the Philippine



Coconut Research and Development Foundation (PCRDF) has helped initiate the first controlled clinical trials in 1998 on the use of tropical oil and / or monolaurin (Lauricidin®) in HIV patients. While the studies have not been completed, early reports are encouraging. The most evident finding is that the quality of life for those unfortunates to have HIV is improved.

Meanwhile over 20 clinics in the USA are now investigating the use of monolaurin (Lauricidin®-Med-ChemLabs., Galena, IL, USA) in various viral diseases including Hepatitis C.

These examples indicate that simple medium-chain saturated lipids, which are non-toxic, and produce nutraceutical effects may represent the new health lipids of the next millennium. A book giving more examples and details is currently in preparation. Again, I wish to emphasize that the Tropical Oil Industry in producing monolaurin as a nutraceutical have a unique opportunity of expanding the economic and medical uses of lauric oils.

Considering all the baseless bad press in the USA that has been given to tropical oils it is time for the coconut industry to advocate an oil change. Our body similar to our car made be in need of an oil change if we want it to function properly and to reach our optimal health.

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Source: www.apccsec.org/apccsec/coconut-oil-5.html

Introuduction

Coconut palm (*Cocos nucifera* L.) is a unique plantation crop which provides all required amenities for human life which include food, drink, beverage, medicine, fibre, and a variety of raw materials for production of an array of products of commercial importance. The state of Assam particularly lower and central Brahmaputra valley is endowed with favourable soil and climatic conditions for growing coconut. In Assam, coconut is mainly a crop of homestead land with small and marginal land holdings. In recent years, coconut is gaining unprecedented popularity all over the states as well as neighbouring states due to its easy adaptability, wide range of uses and higher economic return. The palm is gradually gaining the status of major plantation crop in the state with an annual production of 132.59 million nuts from an area of 19.73 thousand ha and productivity of 6720 nuts/ha (2015-16).

Research work on fruit crops on regional basis was emphasized during second five year plan, which lead to the opening of the eight regional fruit research stations in different states of the country including Kahikuchi as one of the stations in Assam. Thus, the research on fruit crops at Kahikuchi was initiated in the year 1957 with a scheme on pineapple. The establishment was named as Regional Fruit Research

Station in the year 1960-61 after inclusion of research schemes on banana, citrus and temperate fruits. The station was run by the Department of Agriculture, Govt. of Assam till 1973 after which it was handed over to the Assam Agricultural University and was named as Horticultural Research Station (HRS). Prior to handing over to AAU, the research works on coconut were carried out under the state scheme run by the Dept. of Agriculture, Govt. of Assam and during that period research works were mainly concentrated on standardization of spacing, method and time of planting, pit size, method of sowing seed nuts in the nursery, fertilizer requirement for the tall cultivar of coconut etc. Many recommendations as an outcome of the above research works were made for the region and the most notable achievements were the fertilizer requirement for the tall palms and controlling of crown choking disorder of coconut by the application of borax. However, with the establishment of All India Coordinated Research Project (AICRP) on Palms during October 1985, paved the way for conducting more extensive research works on coconut for the benefit of farmers of the region. The Centre is located near Lakapriyo Gopinath Bordoloi Airport (Borjhar) and about 17 km away from Guwahati city. Geographically, Kahikuchi is situated on the 26.30 N latitude, 91.70E longitude and 64 m above the mean

Technological Interventions: Increase in area, productivity and income of coconut farmers in Assam

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sea level. The area received an annual rainfall of about 1200-1500 mm and hot-humid during summer. Periodic dry spell generally occurs from November to March. The maximum and minimum temperature ranges from 190-350°C and 50-260°C, respectively. The soil of the centre is mainly alluvial clay-loam with the pH ranges from 4.4 to 5.5. Under this project, research works have been conducted primarily on crop improvement and natural resource management in coconut with the following mandates.

- To identify, conserve and utilize elite genetic resources for useful traits in palms from different agro-climatic regions and to evaluate performance of varieties/hybrids under different locations and to facilitate release of varieties/hybrids.

- To standardize suitable agro-techniques for optimizing nut yield and quality in coconut.

- To improve input use efficiency and develop location-specific palm based integrated cropping system to enhance the productivity per unit area.

Research Achievements

Crop improvement: Coconut variety/hybrid released

Kamrupa:

A high yielding tall coconut variety was released in the year 2001, which was selection from Assam Green Tall. It is having green colour oblong shaped nuts and an average yield of 100-110 nuts/palm/year and tolerant to stem bleeding, red palm weevil, crown choking and grey leaf spot with copra yield: 2.86 tonnes/ha, oil content: 65.0 %. The variety is recommended for commercial cultivation in Assam state.



Kamrupa



Kalpa Samrudhi

Kalpa Samrudhi (MYD x WCT):

The hybrid was released in the year 2009, with an average yield of 110-130 nuts/palm/year and copra content of 172 g/nut (3.1 t/ha) with 68.0 % oil content. Nuts are yellow-green coloured, oval shaped with tender nut water content of 345 ml/nut. The hybrid is moderately tolerant to stem bleeding, crown choking and moisture stress. It is suitable for copra and tender nut purpose. It is recommended for cultivation in Assam and Kerala.

Crop Production

Nutritional Studies

a) Fertilizer requirement for hybrid coconut

For the hybrid COD x WCT, a fertilizer dose of 500 g N: 500 g P2O5: 2000g K2O per palm in two splits (April and September) has been proved to be the best for recording highest yield of 115 nuts/palm/year and benefit cost ratio of 3.45. This nutritional dose for the hybrid COD x WCT has been recommended for the state of Assam.

b) Integrated nutrient management in COD x WCT hybrid coconut

An integrated nutrient dose for the hybrid coconut COD x WCT has been found to be suitable which gave higher yield of 110.5 nuts/palm/year and benefit cost ratio of 2.02. The dose consisted of N=500 g/palm/year (50% N by urea + 50% N by vermicompost), P2O5= 500 g/palm/year and K2O=2000 g/palm/year and is to be applied in two splits in April and September. This integrated nutrient dose for the hybrid COD x WCT has been recommended for Assam condition.

c) Fertilizer application through micro-irrigation technique

Application of 75% recommended NPK through drip irrigation in coconut during October to April in 10 equal splits at 20- day intervals was recommended which resulted significantly higher growth, yield and benefit cost ratio (2.27) compared to other treatments.

Coconut based cropping system

a. First generation coconut based high density multispecies cropping system

A high density multispecies cropping system model (1024 m2/ model) comprised of Coconut + Black pepper (Var. Panniyur-1) + Ginger (Var. Nadia) + Assam lemon + Banana (Var. Chenichampa) + Pineapple (Var. Kew) was established and recommended which gave a net return of Rs. 67,375/ha with a benefit cost ratio of 1.67. Soil microbial population (bacteria, fungi and actinomycetes) was also recorded higher in the aforesaid model compared to monocropping.

b) Second generation coconut based high density multispecies cropping system

A profitable coconut based cropping system comprising of Coconut + Black pepper + Turmeric was recommended for the region which gave a net return of Rs.79,038/ha with benefit cost ratio of 1.56.

c) Development of coconut based integrated cropping system

The coconut based integrated cropping system model covering of 0.4 ha with crop components such as Turmeric (var. Megha), Pineapple (var. Kew), Assam lemon, Banana (Chenichampa) and Black pepper (Var Panniyur-1) along with coconut as monocrop were evaluated. Yield of coconut was increased from 55 nuts/palm/year to 66.0 nuts/palm/year with a per cent on nut increase of 20.0 % over a period of three years under CBCS. Soil and leaf nutrient (NPK) as well as earthworm and soil microbial population (Bacteria, fungi and actinomycetes) were increased compared to monocropping system. This model has a potential to earn more profit of Rs. 239,075/ha with a benefit cost ratio of 1.75.

d) Medicinal and aromatic plants in coconut garden

Three medicinal plants viz., Sarpagandha (*Rauvolfia serpentina*), Pipali (*Piper longum*) and Vedailota (*Paederia foetida*) and two aromatic plants viz., Citronella (*Cymbopogon winterianus*) and Patchouli (*Pogostemon cablin*) were evaluated. Intercropping system of growing patchouli under coconut was recommended which recorded the highest net income of Rs. 178.089/ha with B:C ratio of 3.26 followed by intercropping with sarpagandha.

“In Assam, coconut is mainly a crop of homestead land with small and marginal land holdings. In recent years, coconut is gaining unprecedented popularity all over the states as well as neighbouring states”

The nut yield of coconut improved with intercropping with medicinal and aromatic crops.

e) Flower crops as intercrops in coconut garden

When five commercial flowering crops viz., Tuberose (*Polianthes tuberosa*) var. Single, Gerbera (*Gerbera jamesonii*) var. Red Monarch, Bird of Paradise (*Strelitzia reginae*) var. Glauca, Gladiolus (*Gladiolus grandiflorus*) var. Oscar, Marigold (*Tagetes erecta*) var. Siracole along with a control (coconut alone) were evaluated as intercrops in coconut garden, coconut equivalent yield was significantly higher in coconut + gerbera followed by coconut + tuberose and coconut + gladiolus with net return of Rs. 511,270/ha, Rs. 346,840/ha and Rs. 336,630/ha respectively, compared to coconut monocrop (Rs. 61,780/ha).





Biomass recycling through vermicomposting in CBCS

The dried leaves and spathe of coconut, waste materials of the intercrops such as leaves and pseudostem of banana, leaves of turmeric and pineapple were collected, quantified and left for weathering. The weathered materials of coconut and other intercrops were used for vermicomposting. Glyricidia leaves collected from the plants raised in the boundary were also used for vermicomposting. It can be done with the help of earth worm *Eudrilus sp.* and the biomass can be recycled. On an average, 2004.0 kg of dried biomass can be obtained from the CBCS every year and around 2.4 tons of vermicompost can be produced per year. Vermiwash can also be collected during the process of vermicomposting and applied to coconut and intercrops. Recycling of biomass minimized the dose of application of inorganic fertilizer and thereby reduced the cost of production per ha.

Nursery seedling production

Apart from the research and extension activities, the station has been producing a good number of quality coconut seedlings of the promising types, particularly the 'Kamrupa' every year which are being sold and distributed to the farmers in the states and to the neighbouring states.

Extension activities

The All India Coordinated Research Project on

Palms at Horticultural Research Station, Kahikuchi has been playing a significant role since its inception in various extension activities for transfer of technologies in the farmers' field to promote coconut culture as well as horticulture as a whole in the region. The various suitable technologies developed for coconut cultivation under AICRP on Palms and other schemes have been disseminated to the farming community through training, method demonstrations, awareness programme such as holding World Coconut Day, Coconut Show & Competition, Kesan Mela and Scientist-farmer interaction.

With the above research and extension activities which are being carried out by the station, and developmental activities taken up by the Coconut Development Board, might have an impact for the overall development of coconut industry in the state and as an outcome of R & D, a steady increase in area and production of coconut over the years have been noticed. Coconut production in Assam during 1985 was 57.41 million nuts from an area of 8034ha. The present production of coconut is 132.59 million nuts from an area of 19,730 ha (2015-16). Thus, there was an overall increase of 130.9 % per cent in production and 145.6 per cent in area over a period of 30 years.

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AHA and the hidden corporate war against Coconut oil

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The American Heart Association (AHA) recently released a controversial Presidential Advisory on Dietary fats, demonizing the use of coconut oil as a cooking fat. The advisory guided the American population to replace saturated fats including coconut oil and replace them with vegetable oils containing polyunsaturated fats as a recipe to reduce the risk of cardio vascular diseases by 30 per cent. According to the advisory, coconut oil has been found to raise LDL cholesterol, which in turn will increase the risk of cardio vascular diseases. Frank M Sacks of the Harvard T.H. Chan School of Public Health is the lead author of the report. Frank Sacks is also a key figure associated with Menus of Change, an organization sponsored by 48 Food Product Corporations. Major sponsors of Menus of Change include Unilever brands and Northern Canola Organization. Unilever has vested interests in promoting highly processed vegetable oils including soybean oil. Unilever owns major vegetable oil brands. Northern Canola Organization is an agency engaged in encouraging the cultivation of genetically modified canola and canola oil. The authors, who prepared the recent Presidential Advisory on Dietary fats, vilifying coconut oil have potential private funded conflict of interests. The major sponsors of AHA are the corporate promoters of genetically modified canola and soybean. Rather than reducing the risk of cardio vascular diseases among American population, the real motive behind the Presidential Advisory is the protection of the vested interests of American Trans National Corporations.

Apart from the potential conflict of interests, the directive against coconut oil itself is aligned with outdated, obsolete research studies. The guidelines are not based on any new scientific information or research studies. It is based on decade old, faulty studies. AHA is in the habit of declaring certain dietary components as unhealthy in one fine morning and withdrawing the warning and ban after the lapse of certain period of time. However the Association has been continuously engaged in a war against coconut oil for the last 50 years. New advisory is only a continuation of this undeclared war against coconut oil.

There is no systematic and conclusive evidence linking the dietary use of coconut oil and the increased risk of cardio vascular diseases. In fact, many research studies have been published in recent times highlighting the health benefits of using coconut oil as a dietary fat. However, authors of the AHA report have cherry picked four research studies to support the risk of using coconut oil in diets. These outdated research studies were published in the 1960s and 70s. AHA authors have repeated the results of these studies once again in their new Presidential Advisory on Dietary Fats. These studies were conducted using out dated and faulty research methodologies. AHA has been using the findings of these studies again and again with vengeance against coconut oil at regular intervals. Multiple other meta- analysis had found weak evidence or no evidence to link the dietary use of coconut oil and increased risk of Cardio Vascular Diseases.

Between 1980 and 2017, the AHA released eight Presidential Advisories on dietary fats. There are at least 17 systematic reviews and meta-analyses conducted in recent years that found no relationship between saturated fat consumption and cardiovascular diseases. Authors of the AHA report, however conveniently hand picked four old studies. None of these four studies were conducted on the basis of elaborate and systematic clinical studies. In the introduction of the recent AHA presidential advisory on Dietary Fats, the authors noted that in the past few years, meta-analyses of observational studies and randomized clinical trials have come to discordant conclusions about the relationship between dietary saturated fat and risk of CVD. Ignoring this, the AHA authors selected only four core studies published in 1969, 1970, 1968 and 1979 which were not based on large scale scientific and reliable clinical trials.

The controversy linking saturated fats and CVD started in 1954 when David Kritchevsky published a research paper. Kritchevsky fed vegetarian rabbits with processed cholesterol and reported that the cholesterol clogged the arteries of rabbits and led to CVD. Soybean oil industry made use of the study in their favour. In 1957, Ancel Keys came forward with the hypothesis that saturated fats raise serum cholesterol which in turn increases the risk of heart disease. This hypothesis is popularly known as the saturated fat-cholesterol-heart disease hypothesis. Even though the most often studied saturated fats are animal fats, coconut oil is often included in the hypothesis because it is also a saturated fat. The Ancel Keys's hypothesis linking saturated fats and heart disease found a place in the first presidential advisory on dietary fats published in 1980.

Ancel Keys conducted both human feeding and observational studies. His research was faulty, on many accounts. In human studies Keys used hydrogenated coconut oil. In his observational studies, coconut oil was only a minor component. Sources of saturated fats that Keys used in his studies were butter fat, margarine and hydrogenated coconut oil known as hydrol. The use of hydrol and margarine casts doubts about the validity of Ancel Keys's studies. The increase of serum cholesterol might have been due to the trans fats in margarine and hydrogenated coconut oil making his conclusions invalid. Ancel Keys used hydrogenated coconut oil to

make his biased judgment against pure coconut oil. More over, Keys was never able to unambiguously prove this hypothesis linking saturated fats and cardiovascular diseases. Frank Sacks and co-authors of the 2017 presidential advisory on dietary fats rely upon the decades old same hypothesis of Ancel Keys to vilify coconut oil. They advise the world to replace coconut oil and use corn oil, soybean oil, canola oil and extra virgin olive oil as cooking fats.

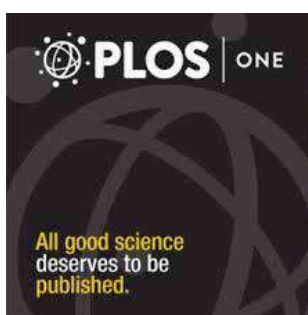
The AHA founded in 1924 claims that it is a non-profit organization. However, the working fund for the functioning of the Association is provided by major American Multinational Companies including Unilever, Monsanto, BASF, Bayer and Procter and Gamble.

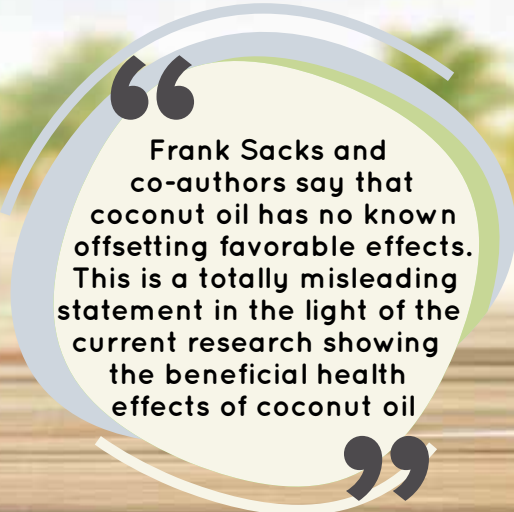
Many of the recommendations of AHA are influenced by the vested interests of these transnational corporations. Without conclusive scientific evidences, the association has been engaged in a continuous hidden war against coconut oil. Compared to coconut oil, more number of research studies were published in the recent past regarding the unhealthy effects of polyunsaturated fats contained in vegetable oils like canola oil, soybean oil and corn oil. But the American Heart

Association ignored these research findings against vegetable oils, especially soybean oil.


A research article published in PLOS one journal in 2015 revealed that increased consumption of soy bean oil which is rich in polyunsaturated fatty acids (PUFAs) has been a major causal factor for the obesity epidemic in the US. The recommendation for decreased saturated fat consumption as per guide lines issued by American Heart Association led to a 1000 per cent increase in the consumption of soybean oil in the US from 0.01 to 11.6 kg per year per capita between 1909 and 1999. In rat feeding experiments, soybean oil induced diabetes, glucose intolerance and insulin resistance. Soybean oil also caused fatty liver, hepatocyte ballooning and accumulation of fatty acid metabolites in liver. The authors concluded that in mice, a diet high in soybean oil is more detrimental to metabolic health than a diet high in fructose or coconut oil.

Globally half of the vegetable oil production is from soybean. In US, 90 percent of the vegetable oil production is from soybean. Multinational companies engaged in food processing and marketing of seeds and weedicides spend millions of dollars annually for the promotion of genetically modified soybean





“ Frank Sacks and co-authors say that coconut oil has no known offsetting favorable effects. This is a totally misleading statement in the light of the current research showing the beneficial health effects of coconut oil ”



cultivation and consumption of soybean oil. The hatchet job on coconut oil is part of a long term misinformation campaign spear headed by the AHA with the multinational companies behind them. The real objective behind this misinformation strategy is to tarnish the image of any cooking oil that is perceived to give even a slightest challenge to soybean oil. Frank Sacks, lead author of the report, repeatedly stated that he has no idea why people think coconut oil is healthy. In the Presidential Advisory on dietary fats, Frank Sacks and co-authors say that coconut oil has no known offsetting favorable effects. This is a totally misleading statement in the light of the current research showing the beneficial health effects of coconut oil. AHA, which functions like a terrorist group against coconut oil is only a front organization of the big industry.

94 percent of soybean cultivated in the US is the genetically modified roundup ready soya bean of Monsanto Corporation. Round up ready soybean is genetically modified to exhibit resistance to the glyphosate based weedicide popularly known as round up. The genetically modified soybean will withstand the sprayings of round up weedicide, whereas all the weeds will be destroyed. The international agency for research on cancer under the WHO has evaluated glyphosate as a possible carcinogenic agent. The roundup ready soya bean was introduced for commercial cultivation in the US in the mid 1990s. The area under roundup ready soybean in the US in 1997 was 17 percent of area under soybean cultivation. This was increased to 94 percent in 2014.

In the last 20 years ‘super weeds’ exhibiting resistance to round up weedicide had emerged in many parts of US. As a solution to this, the Syngenta and BASF companies have introduced a more harmful weedicide Diacamba in 2017. Monsanto

is planning to introduce new toxic combinations of weedicides with glyphosate and other commercial weedicides in the market. The vegetable oil and food processing industry in the US. is totally dependent upon the commercial cultivation of genetically modified soybean. It is the need of these multinational companies promoting genetically modified soybean to maintain the current market share of soybean oil at any cost, By continuously attacking coconut oil at regular intervals, the AHA which bears the mask of a nonprofit, independent organization is trying to satisfy the hidden agenda of the American multinational companies engaged in seed, weedicide and soybean based food processing business.

Two representatives of American Canola Association are also members in the nutritional advisory panel of AHA. Almost all canola crops grown in US. are genetically modified to be resistant to herbicides especially glyphosate. Canola consumption has been linked to Vitamin E deficiency, and a shortened life span in animal studies. Modern canola plants have been bred to have lower levels of toxic erucic acid, which is naturally occurring, in all natural forms of rapeseed and mustard. Canola cultivated for food use typically contains erucic acid below 0.5 %. However, animal feeding studies revealed that the ingesting oils containing erucic acid over a period of time can lead to a heart condition called myocardial lipidosis, a temporary and reversible disorder.

Because of the faulty nutritional policies of AHA, the cholesterol content in American diet decreased to 34 percent from 45 percent between 1971 and 2011 and that of fructose, sugar and carbohydrates increased to 51 percent from 39 percent during the same period. Even though the incidents of obesity, heart diseases and diabetes increased considerably, the AHA never bothered to look in to scientific

evidences to revise their nutritional guidelines and recommendations.

Because of general prejudice and bias against coconut oil propagated by agencies like AHA, the potential benefits of coconut oil is kept buried in medical journals. It has the potential to protect against a wide variety of chronic health problems. Coconut oil is rich in medium chain fatty acids (lauric acid.) They do not participate in the bio synthesis and transport of cholesterol. MCFAs are directly absorbed from the intestine and sent straight to the liver to be rapidly used for energy production. This in fact is a cardio protective attribute of coconut oil. Coconut oil has been a primary source of dietary fat for thousands of years in Sri Lanka, Samoa and other Pacific Islands and some of the South East Asian Countries. Some of these countries have lowest heart disease rates in the world. Compared to Sri Lanka, the United States of America where people relied more or on polyunsaturated fats from soybean, canola and corn oils, deaths due to heart diseases are at least 280 times higher.

Compared to unsaturated fatty Acids, more studies have been conducted on the unhealthy effects of polyunsaturated fatty acids. Soya bean oil is rich in omega -6 fatty acids, which is needed by the human body. However, American people are getting omega-6 fatty acids up to 20 times more than required through processed food items, Some research studies have revealed that over abundance of Omega-6 fatty acids increases the risk of inflammation, Cardio Vascular diseases, Cancer and auto immune diseases. The AHA never bothered to issue dietary guidelines about the over abundance of soya bean oil in American diet and its adverse effects on human health.



AHA has been implementing a programme named Heart Check Programme, for labeling and certifying certain products as safe for heart. The Association is issuing these certificates to highly processed food products of fast food chains which contain high content of soybean oil, fructose and other artificial chemical components. Certificates are issued purely on monitory consideration without scientifically evaluating the health effects of ingredients incorporated in such food products. Corporate companies which are able to pay heavy fee are the beneficiaries of the Heart Check Programme of AHA. When it comes to coconut oil, AHA always follows a dubious standard. The funding sources of AHA also includes big pharmaceutical companies like Amarin, Amgen, Astra Zeneca, Eli Lilly , Glaxo Smith Kline, Merck and Pfizer. There are allegations that the AHA has been formulating many recommendations for helping these big pharma companies for enhancing the sale of statin drugs for reducing bad cholesterol.

Over the years, the AHA has been following a three pronged strategy for promoting the vested interests of the American multinational companies. Their first strategy is the periodic releasing of dietary guidelines advising the consumers to replace coconut oil with polyunsaturated fatty acid rich vegetable oils like soybean oil and canola oil. The other strategies are the propaganda for wide use of statin drugs for reducing cholesterol and the advisory for the consumption of food product checked and certified by AHA as safe to heart and human health. In a recent survey it was found that 72 percent of the American population considered coconut oil as a healthy food. However only 32 percent of the nutrition experts supported this view point.

It is estimated that the market for coconut milk will register an annual growth rate of 15.4 percent by 2020. Demand for Virgin Coconut oil and other coconut food products are also increasing in the international market. This growing demand for coconut food products may become a cause of worry for the soybean , corn and canola based food industries. Representatives of the companies like Nestle, Coca-Cola, The Sugar Association, the United Soybean Board and US Canola association serve in the industry Nutrition panel of AHA. These corporate leaders might be able to influence the important nutritional recommendations of AHA. The debate on saturated fats has been continuing for the last one hundred years. The claims made against coconut oil in the AHA report do not stand up to standard systematic research results. ■

WORLD COCONUT DAY

State Centre Thane



Coconut Development Board, State Centre, Thane and DSP farm Palghar celebrated World Coconut Day on 2nd September 2017 in association with Department of Agriculture, Govt. of Maharashtra and Thane District Coconut Growers Association, Palghar. Dr.Prashant Narnaware, IAS, Collector cum District Magistrate, Palghar inaugurated the programme. Shri.E. Aravazhi, Deputy Director, Coconut Development Board, Shri. Yadnesh V. Save, President, Thane District Coconut Growers Association, Dr.S.B. Gangawane, Officer In charge, Agriculture Research Station, Palghar, Shri.Rajeshwar G.Patil, District Superintendent Agriculture Officer, Palghar, Dr.Dilip Nagwekar, Agronomist (Rtd), RCRS Bhatye, Shri.Anant Nana Raut, Progressive farmer, Mahim and Shri.P.M. Chandwade, Project Director, ATMA, Palghar were present during the occasion. Shri.Pramod P. Kurian, Assistant Director, Coconut Development Board, DSP Farm Palghar Thane delivered the welcome address.

Dr.Prashant Narnaware, IAS, Collector cum District Magistrate, Palghar in his address advised to Farmer Producer Organizations in Palghar District for the benefit of the farmers. He emphasized the scope for expansion of area under coconut and training programme for coconut related products. A technical Session was also held as part of the programme.

Coconut Development Board, Regional Office, Bangalore in association with Mangalore Jilla Coconut Producer Federation celebrated World Coconut day at Moodabhidri., Dakshina Kannada district on 2nd September 2017. Shri. Rajesh Naik, Organic coconut farmer inaugurated the programme and Shri. Mahabala Bhat presided over. In his inaugural address Shri. Rajesh Naik spoke on the importance of coconut farming. Hon'ble MP Shri. Nalin Kumar Kateel, in his felicitation spoke on coconut value addition. The President of the Coconut Producer Federations of Dakshina Kannada and Udupi district also spoke during the programme. The inaugural session was followed by a technical session wherein Shri Chinnaraj, Assistant Director, DSP Farm, Mandya delivered the keynote address. Smt. Simi Thomas, Technical Officer, Coconut Development Board and Smt. Prema, Department of Agriculture handled the technical session.

CDB RO Bangalore



International Symposium on Horticulture: Priorities & Emerging Trends



Coconut Development Board, Regional Office, Bangalore participated in the exhibition in connection with International Symposium on Horticulture: Priorities & Emerging Trends from 5th to 8th September 2017 at J.M Tata Auditorium, Malleshwaram, Bangalore. The symposium was organised by ICAR-Indian Institute of Horticultural Research, Bangalore.

Shri. Vajubhai Rudabhai Vala, Governor of Karnataka inaugurated the programme in the presence of Shri. Ananth Kumar, Hon^{ble} Union Cabinet Minister for Parliamentary Affairs, Chemicals & Fertilizers.

Dr. B.N.S Murthy, Horticulture Commissioner & Chairman, Coconut Development Board and Dr. Rethinam, former Chairman, Coconut Development Board visited the Coconut Development Board stall. Coconut Development Board showcased value added products, coconut shell & wood based



handicrafts, publications on coconut products and technologies. Many technical queries on coconut cultivation, processing of value added products, pest and disease management, coconut cultivation, Neera processing & production and CDB schemes were clarified by the Board officials. M/s. Keratech (P) Ltd., and Shri. Ashok Kumar Handicraft manufacturer exhibited & sold their products in the CDB stall.

Krishak Nursery Samadhan- Solutions for Quality Planting Material”

Institute of Horticulture Technology, Greater Noida, Uttar Pradesh organized National Seminar : Krishak Nursery Samadhan, Solutions for Quality Planting Material from 13th to 14th October, 2017 at Directorate of Horticulture and Food Processing campus, Farmers' Training Centre, Khanapara, Guwahati-781022, Coconut Development Board, Regional Office, Guwahati participated in the programme. Shri K.K. Mittal, IAS, Agriculture Production Commissioner, Department of Agriculture, Govt. of Assam, Shri Prabin Hazarika, Director of Horticulture and Food Processing, Govt. of Assam, Shri H.C. Bhattacharjee, Director, Extension Education, Assam Agriculture University, Shri Jayanta Samal, DGM, NABARD, Assam, Shri S.C. Panwar, Joint Director, National Horticulture Board, Assam, Dr. A.K. Tripathy, Director, ICAR, Shri Sanjay Sudan, Co-Chairman, IHT and Dr. Umesh Kohli, Director, IHT attended the programme and spoke about the possibilities of up-skilling the farmers for doubling their income by developing bio entrepreneurship in the North East region.



Seminar on Coconut Cultivation and value addition

A seminar cum training programme on Coconut Cultivation and Value Addition was conducted at Pragna Bhaban, Agartala, Tripura on 11th October 2017. Shri Aghore Debbarma, Hon'ble Agriculture Minister, Govt. of Tripura inaugurated the programme and Shri Jitendra Chaudhury, Hon'ble Member of Parliament (Lok Sabha) East presided over the programme.

Shri. Aghore Debbarma, Hon'ble Agriculture Minister, Govt. of Tripura, in his inaugural address spoke on the importance of coconut and its products to the participants. He requested the farming community to utilize their land for coconut cultivation. He also requested the Board to render all sorts of facilities to the farming communities of the state. Good quality coconut seedlings may be provided to the farmers for increasing the area and production of coconut in all parts of Tripura. He also promised to extend all help to CDB for expansion of their activities in Tripura.

In his presidential address Shri. Jitendra Chaudhury, Hon'ble Member of Parliament (Lok Sabha) Tripura East, spoke on the importance of coconut cultivation and its utility for improving the income of farming community. He emphasized the need to promote coconut cultivation in the state in the scientific way and adopt different technologies for value addition in coconut so that more income of the farmers per unit area can be achieved which can improve the livelihood of the weaker section of the society. He advised the participants farmers to utilize their boundary of the cultivable land and the bank of the pond for coconut cultivation. He assured the Board all help and co-operation for the development of the DSP Farm Hichachara, Tripura.

Shri Saradindu Das, Chief Coconut Development Officer, Coconut Development Board welcomed the guests. He spoke on the importance of coconut cultivation as well as value addition in Tripura for the



up-liftment of the livelihood of the small and marginal farmers of the state. He briefed about the coconut scenario in the world and the position of India as well as Tripura. He stressed on value addition of coconut in his address. Dr. Basant Kandpal, Joint Director, ICAR, Tripura; spoke on the utility of coconut and its value addition. Dr. A.K. Nandi, Secretary CDB proposed vote of thanks.

A technical session followed the inaugural session. Shri Saradindu Das, CCDO, CDB. Kochi chaired the session. Shri Lungar Obed, Director, RO Guwahati, Shri Khokan Debnath, Deputy Director, CDB. SC Kolkata and Dr. Biswajit Das, Principal Scientist, Horticulture, ICAR, Tripura spoke on coconut cultivation, pest and disease, schemes of the Board and prospects of coconut cultivation in Tripura. More than 300 farmers and officials from different parts of Tripura were present in the function. Officers from the department of Agriculture and Horticulture and farmers from different parts of Tripura took part in the programme.



131st Board Meeting



The 131st Meeting of the Coconut Development Board was held on 6th October 2017 at New Delhi under the Chairmanship of Dr. B.N. Srinivasa Murthy, Horticulture Commissioner to the Government of India and Chairman, Coconut Development Board. The meeting was attended by Shri P.C. Mohanan Master, Vice Chairman and members of the Board: Dr. P. Chowdappa, Director, CPCRI, Shri P.R. Muraleedharan, Kerala, Shri S. Mohan Raj, Tamilnadu, Shri M.R. Shankara Narayan Reddy, Karnataka and Shri Sanjeev Kumar Singh, Bihar. Shri S. Janardhanan, Additional Director, Government of Kerala, Dr. G.S. Pandey, Joint Director (Agriculture Engineering), Andaman & Nicobar Administration and senior officials of Coconut Development Board attended the meeting.

Aahar

Coconut Development Board, State Centre, Thane participated in Aahar, the International Food & Hospitality Fair -2017 from 11th to 14th October-2017, at CIDCOI, Exhibition Centre, Vashi, Navi Mumbai, Maharashtra. The fair was inaugurated by Shri. Vijay Waghmare, Managing Director, Maharashtra Tourism Development Corporation, Mantralaya Mumbai.

Coconut Development Board, organized a B2C programme along with the exhibition. The main focus of participation in Aahar and conducting B2C was to facilitate the distributors, entrepreneurs and retailers of coconut products in India to explore new markets. Shri. K.S Sebastian, Assistant Director, Marketing CDB facilitated the B2C meeting which provided the opportunity for the coconut manufacturing

companies to interact with business groups interested in marketing coconut products in India as well as abroad. Around 10 coconut product manufacturers including Coconut Producer Companies took part in the programme.

Coconut Development Board displayed various value added coconut products, like packed tender coconut water, coconut oil, coconut milk powder, virgin coconut oil and well informative charts and other posters in the exhibition. Shri. Vijay Waghmare, M.D. (MTDC) Mantralaya Mumbai and other senior officials of ITPO, officials of various National companies, business communities visited CDB Stall. The exhibition was organized by India Trade Promotion Organization, a Government of India Enterprise at Mumbai.



Market review – September 2017

Domestic price



Coconut Oil

During September 2017 the price of coconut oil opened at Rs. 15700 per quintal at Kochi market, Rs. 15500 per quintal at Alappuzha market and Rs.16800 per quintal at Kozhikode market. The price movement in all three markets in Kerala expressed an upward trend from during the first three weeks. During the fourth week, the price of coconut oil at all three markets declined and thereafter expressed an upward trend.

The price of coconut oil closed at Rs.16900 per quintal at Kochi market and Alappuzha market and Rs.18500 per quintal at Kozhikode market with a net gain of Rs.1200, Rs.1400, and Rs. 1700 per quintal respectively.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.14000 per quintal, expressed a similar trend of that of Kerala markets and closed at Rs.15333 per quintal with a net gain of Rs.1333 per quintal.

	Kochi	Alappuzha	Kozhikode	Kangayam
03.09.2017	15700	15500	16800	14000
10.09.2017	16700	16200	17700	14867
17.09.2017	16800	16900	18500	14667
24.09.2017	16600	16600	18400	15333
30.09.2017	16900	16900	18500	15333



Milling copra

The price of milling copra at major markets moved in tune with the prices of coconut oil. During the month, the price of milling copra opened at Rs.10800 per quintal at Kochi, Rs.10450 per quintal at Alappuzha market and Rs.10900 per quintal at Kozhikode market. The price movement in all three markets in Kerala expressed an upward trend during the first three weeks. During the fourth week the price of milling copra at all three markets declined and thereafter expressed an upward trend.

The prices closed at Rs.11700 at Kochi, Rs.11350 per quintal at Alappuzha market and Rs.12100 at Kozhikode markets with a net gain of Rs.900 per quintal at Kochi and Alappuzha market and Rs.1200 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices



expressed an upward trend. The prices opened at Rs.9700 and closed at Rs. 10600 per quintal with a net gain of Rs.900 per quintal.

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan- gayam
03.09.2017	10800	10450	10900	9700
10.09.2017	11700	10800	11500	10100
17.09.2017	11800	11450	12000	10500
24.09.2017	11600	11300	11900	10500
30.09.2017	11700	11350	12100	10600

Edible copra

The price of Rajapur copra at Kozhikode market which opened at Rs.12800 per quintal expressed upward trend during the first three weeks of the month. During the fourth week the price of edible copra declined and thereafter expressed an upward trend. The prices closed at Rs.14400 per quintal with a net gain of Rs.1600 per quintal

Table3 :Weekly price of edible copra at Kozhikode market (Rs/Quintal)

03.09.2017	12800
10.09.2017	14200
17.09.2017	14800
24.09.2017	14100
30.09.2017	14400

Ball copra

The price of ball copra at Tiptur market which opened at Rs.12500 per quintal expressed a mixed trend during the month and closed at Rs.13000 with a net gain of Rs. 500 per quintal.

Table 4 : Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)

	Tiptur
03.09.2017	12500
10.09.2017	13500
17.09.2017	13500
24.09.2017	13000
30.09.2017	13000

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.8500 per quintal. The price expressed an upward trend during the first fortnight of the month and thereafter expressed a declining trend and closed at Rs.10300 with a net gain of Rs.1800 per quintal.

Table5 : Weekly price of Dry Coconut at Kozhikode market (Rs/1000 coconuts)

03.09.2017	8500
10.09.2017	11600
17.09.2017	10900
24.09.2017	10400
30.09.2017	10300

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs. 16000 and closed at Rs. 18000 with a gain of Rs.2000 per thousand nuts. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs. 14000 and closed at Rs.17000 per thousand nuts with a net gain of Rs.3000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs.13750 per thousand nuts and closed at Rs.13500 per thousand nuts with a net loss of Rs.250 per thousand nuts. At Mangalore APMC market the price of partially dehusked coconut of grade-I quality opened at Rs.21500 per thousand nuts and closed at Rs.22500 per thousand nuts with a net gain of Rs.1000 per thousand nuts.

Table 6: Weekly price of coconut at major markets (Rs /1000 coconuts)

	Neduman-gad	Pollachi	Banglore	Mangalore (Grade-1)
03.09.2017	16000	14000	13750	21500
10.09.2017	16000	15000	13750	21500
17.09.2017	18000	17000	13750	22500
24.09.2017	18000	17000	13500	22500
30.09.2017	18000	17000	13500	22500

Tender coconut

The price of tender coconut at Maddur APMC market in Karnataka opened at Rs.10000 per thousand nuts and remained at the same level throughout the month.

Table7 : Weekly price of tender coconut at Maddur market (Rs/1000 coconuts)

03.09.2017	10000
10.09.2017	10000
17.09.2017	10000
24.09.2017	10000
30.09.2017	10000



International price

Coconut oil

The international and domestic price of coconut oil at Philippines and Indonesia expressed a declining trend the from the second half of the month, whereas in India the price of coconut oil expressed an erratic trend. The price of coconut oil quoted at different international/ domestic markets is given below.

Table 8: Weekly price of coconut oil in major coconut oil producing countries during September 2017

	International Price(US\$/MT)	Domestic Price(US\$/MT)		
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	India*
02.09.2017	1542	1588	1580	2436
09.09.2017	1640	1600	1600	2591
16.09.2017	1573	1570	1570	266
23.09.2017	1517	1570	1570	2575
30.09.2017	1444	1500	1501	2622

* Kochi Market



Coconut

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

Table 11: Weekly price of dehusked coconut with water during September 2017

Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
02.09.2017	180	225	307	496
09.09.2017	186	225	322	527
16.09.2017	189	221	318	590
23.09.2017	202	214	345	605
30.09.2017	203	207	NQ	605

*Pollachi market

Copra

The domestic price of copra at Philippines expressed a declining trend whereas price of copra in Indonesia and Srilanka were almost ruling at same price during the month. The price of copra in India expressed a mixed trend. The price of copra quoted at different domestic markets are given below.

Table 9: Weekly price of copra in major copra producing countries during September 2017

	Domestic Price(US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
02.09.2017	948	987	1506	1675
09.09.2017	914	987	1506	1675
16.09.2017	908	987	1506	1831
23.09.2017	905	987	1506	1800
30/09/2017	899	954	NQ	1815

* Kochi Market

Desiccated coconut

The price of desiccated coconut in major desiccated coconut exporting countries are given below:

Table 10: Weekly price of desiccated coconut during September 2017

	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
02.09.2017	2502	2430	3052	2634
09.09.2017	2502	2430	3124	2688
16.09.2017	2508	2430	3283	2702
23.09.2017	2508	2430	3294	2731
30.09.2017	2508	2430	NQ	2762

*FOB



Monthly operations in coconut garden - November



Andaman & Nicobar Islands: Treat stem bleeding affected palms if any. After removing the affected tissues on the stem, apply 5 per cent calixin on the wound. When it dries apply warm coal tar. Application of 5 per cent calixin (5 ml in 100 ml water) at quarterly intervals by root feeding thrice a year during June, October and January will prevent further spread of lesions. Apply 5 kg neem cake per palm per year along with the second dose of fertilizers to the affected palms. Regulate field moisture by providing drainage during rains and irrigating the palms during summer. Remove ungerminated and dead sprouts from the nursery.

Andhra Pradesh: In low lying areas, plant one year old seedlings in the main field. If there is attack of black headed caterpillar, spray young seedlings with 0.2 per cent dichlorvos/0.05 per cent endosulphan/0.05 per cent phosalone on the lower side of the leaves. On older palms, release specific parasites according to the stage of the pest. Inject the red palm weevil affected palms with one per cent carbaryl. When the pest entry is through the trunk put Aluminum phosphide tablets @1-2 tablets per tree in the holes and plug with cement or plaster and allow to set. Isolate Ganoderma wilt affected palms from healthy ones by digging trenches of 30 cm width and one metre depth, 2 metres away from the diseased palms. Treat the palms with 5 per cent calixin (5 ml

in 100 ml water) at quarterly intervals by root feeding for one year. Grow leguminous crops in the garden. Apply neemcake @ 5kg/ palm/year. Apply the second dose of fertilizers i.e. 750 g urea, 1300 g single superphosphate and 1300 g muriate of potash per adult palm, if not applied in October.

Assam: If Ganoderma disease is noticed remove the badly affected palms and dig isolation trenches of 30 cm width and 1m depth, two metres away from the diseased palm. Treat the palms with 5 per cent calixin (5 ml in 100 ml water) at quarterly intervals by root feeding and apply 5 kg neem cake per palm. Treat the crown choke affected palms by the application of 50g borax per palm at half yearly interval.



Bihar / Madhya Pradesh/Chhattisgarh: Keep the garden free of weeds. Remove the soil from the collar region of the newly planted seedlings. Apply the first dose of fertilizers. In order to protect the seedlings from winter effect, provide shade. Search for the attack of termites. If found, clean the termite galleries from the affected portion and apply 0.05 per cent chlorpyrifos twice at 20-25 days interval. Irrigate the garden. Cultivate vegetables as intercrops.

Karnataka: Plough the garden and keep nursery free of weeds. Start irrigation if dry spell prevails. Apply the 2nd dose of fertilizers if not applied during October. Crown cleaning may be taken up if not done in earlier months. Bordeaux mixture may be sprayed if not applied last month.

Kerala/Lakshadweep: Manure the young seedlings. Start the post monsoon prophylactic spraying of the palms. Discard the seedlings in the nursery which exhibit poor growth and delayed germination. Provide shade to the nursery. Select mother palms for collection of seednuts. In gardens where vegetables are grown under irrigation, transplant the vegetable seedlings. To control the leaf rot disease in root (wilt) affected areas, pour Hexaconazol (Contaf 500) @ 2 ml per 300 ml water per palm, after cutting and removing the rotten portion of the spindle and the innermost fully opened leaves. Apply 20 gm phorate 10G mixed with 200 gm sand around the base of the spindle. If mite infestation is noticed clean the crowns of the palms and spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion +5 gm soap in 1 litre water) or azadiractin 1 % (Neemazal) @ 4ml per litre of water or root feed 5 % azadiractin @ 7.5 ml with equal quantity of water.



Maharashtra/Goa/Gujarat: Weed the garden. Clean the irrigation channels. Spray the palms with one per cent bordeaux mixture.

Orissa : Continue the ploughing in low-lying areas to conserve moisture. Remove weeds and grass and burn them. Transplant seedlings of winter vegetables.

Tamil Nadu/Puducherry : Irrigate the young seedlings. Keep the nursery free of weeds and continue discarding poor seedlings. Select mother palms for subsequent seednut collection. Palms affected with mite infestation may be applied with neem oil-garlic- soap emulsion 2 per cent, i.e. 20 ml neem oil+5 gm soap in 1 litre of water or azadiractin 1 per cent @ 4 ml per litre of water on the perianth region of buttons and affected nuts. Root feeding 5% azadiractin @ 7.5 ml with equal quantity of water is also effective. Apply 20 gm phorate 10G mixed with 200 gm sand around the base of the spindle against rhinoceros beetle and red palm weevil.

Tripura: Entire garden should be cleaned properly if not done earlier. Newly planted seedlings should be provided shade to protect them from sun scorching. Mulching should be done with dry leaves and husk around the palms for moisture retention. To avoid attack of white ants, drench the nursery with 0.05 per cent chlorpyrifos twice at 20-25 days interval depending upon the severity of infestation. The affected trunk may be swabbed with the above chemical.

West Bengal: Apply the second dose of fertilisers if not applied during October. Discard seedlings which exhibit poor growth and delayed germination in the nursery. ■

