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Quantum leap in Desiccated Coconut Powder export

K.S. Sebastian
Asst. Director (Marketing), Coconut Development Board, Kochi - 11

Desiccated coconut powder is one of the most traded coconut products in the international market following coconut oil and copra. Desiccated coconut powder is used world over in cookies, biscuits and other bakery products. Presently around six lakh metric tonnes of desiccated coconut powder is being produced worldwide. Philippines tops the list in the production of desiccated coconut powder followed by India, Indonesia and Sri Lanka. However, India is nowhere seen in the list of major exporters of desiccated coconut powder. Philippines, Indonesia, Sri Lanka and Vietnam are the major exporters of the product. The production and export details of major producers of desiccated coconut powder are given in table 1.

Table 1: Major Desiccated Coconut Producing Countries and their contribution to export

Country	Production (in lakh MT)	Production (in %)	Export (in lakh MT)	Export (in %)
Philippines	1.50	25.00	1.20	27.27
Indonesia	0.95	15.83	0.90	20.45
Srilanka	0.55	9.17	0.50	11.36
Vietnam	0.45	7.50	0.40	9.09
Ivory Coast	0.40	6.67	0.30	6.82
Dominican Republic	0.35	5.83	0.30	6.82
India	1.00	16.67	0.05	1.14
Others	0.80	13.33	0.75	17.05
Total	**6.00**	**100.00**	**4.40**	**100.00**

> Daily consumption of desiccated coconut yields better health

Table 2: Major Desiccated Coconut Powder Importing Countries		
Sl. No.	Country	Domestic Demand (In lakh MT)
1	USA	0.50
2	Brazil	0.25
3	Singapore	0.25
4	Germany	0.15
5	Turkey	0.15
6	Britain	0.15
7	Russia	0.15
8	Belgium	0.10
9	Netherlands	0.10
10	Holland	0.10
11	Spain	0.10
12	Canada	0.10
13	Australia	0.10
14	Pakistan	0.10
15	UAE	0.10
16	Egypt	0.10
17	Iran	0.10
18	Others	1.80
	Total	4.40

Largest importers of desiccated coconut powder are USA, Brazil, Singapore, Germany, Turkey, Britain and Russia. Egypt, Iran, UAE, Pakistan and almost all the European nations also import desiccated coconut powder of sizable quantities. The current domestic demand of desiccated coconut powder in major importing countries is provided in table 2.

There are currently over 150 desiccated coconut powder production units in India. Of which around 100 are located in Karnataka. The total production capacity of all the production units in India would come around one lakh metric tonnes. Due to the huge domestic demand and attractive domestic price, desiccated coconut powder producers hadn't paid much attention to the export market. This is one of the main reasons why India lags behind in the export of desiccated coconut powder. We can see that till 2015-16 our exports had been well below 5000 metric tonnes. But however in the following year 2016-17 we were able to quadruple the earlier amount that is to around 20000 metric tonnes.

India is one of the largest consumers of desiccated coconut powder. Desiccated powder is widely used across India and is high in demand wherever the availability of fresh coconut is limited viz. in North India and North East India.

Since in the

The major desiccated coconut powder exporters from India:

- Vittal Agro Industries, Kanhangad, Kasargod, Kerala
- Srihari Industries, Bikaner, Rajasthan
- PSS Varadarajan and Sons, Tripunithura, Ernakulam, Kerala.
- South Indian Industries, Kozhikode
- Sri Krishna Coconut Producer Company, Dindigul, Tamil Nadu
- Super Coco Company, Pollachi, Tamil Nadu
- Trident Creation, Andheri, Mumbai

Table 3 Major countries importing Desiccated Coconut Powder from India		
Sl. No.	Country	Quantity (in MT)
1	U.A.E	5600
2	Egypt	2300
3	Iran	2000
4	Brazil	1900
5	Saudi Arabia	1700
6	USA	1150
7	Spain	1050
8	Kuwait	700
9	Poland	600
10	Qatar	550
11	Yemen	300
12	South Africa	300
13	France	200
14	Ukraine	200
15	Morocco	200
16	Bahrain	200
17	Nepal	150
18	Algeria	150
19	Turkey	100
20	Israel	100
21	Belgium	100
22	Other Countries	1450
22	Total	21000

Duty Drawback Scheme to continue under GST

As a relief to exporters, the government has announced that the dutydrawback scheme would continue under GST (Goods and Services Tax). "Drawback scheme continues under GST. Existing rates of drawback to continue with minor changes for three months (1.7.17-30.9.17)," the Central Board of Excise and Customs (CBEC) has said.

domestic market, price dominates over quality, almost none of the producers of desiccated coconut powder cared much about quality standards till recently. Besides our products did not conform to international quality standards there were fewer trade enquiries from other countries. However currently winds of change have blown in this sector. This is mainly because of the commissioning of over a dozen new desiccated coconut powder units and the importance they give to quality. In the year 2016-17 our products have been increasingly exported to US and European markets. The details and lists of countries to which desiccated coconut powder imported is given in table 3.

If the domestic price of raw material is not undergoing unprecedented spurt, the growth in export would sustain in the coming years. In the year 2020-21 the export of desiccated coconut powder is expected to reach a whopping 50000 metric tonnes. The expected growth in export of desiccated coconut product is given in table 4.

Table 4 : Anticipated growth in export from India for the next four years

Year	Export (in MT)
2017-18	25,000
2018-19	32,000
2019-20	40,000
2020-21	50,000

Large number of processing units which have an eye on the increasing domestic and export demand are expected to come up in the coming years. The financial support from Technology Mission on Coconut, export incentive schemes of Government of India and efforts of Coconut Development Board to find new markets will surely bring new entrepreneurs to the desiccated coconut powder sector.

Export Promotion Activities

Government of India is providing export incentive to boost India's exports under Foreign Trade Policy 2015-20. Entrepreneurs are entitled to receive the following incentives for export of desiccated coconut powder.

(1) Merchandise Exports from India Scheme (MEIS): Under the MEIS scheme, the Government of India provides incentive for exporting notified goods/ products to notified markets.

(2) Duty Drawback Scheme: Duty Drawback has been one of the popular and principal methods of encouraging export. It is a method of refund of custom duties paid on the inputs or raw materials and service tax paid on the input services used in the manufacture of export goods.

Details of export incentive applicable to export of desiccated coconut powder is stated in table 5.

Table 5 : Benefits for desiccated coconut powder under MEIS and Duty Drawback Scheme

ITC HS Code	08011100
Products	Desiccated coconut
MEIS benefits in percentage of FOB Value	5
Duty Drawback Scheme benefit in percentage of FOB Value	1

Taste the nature with Vittal's Desiccated Coconut powder

Vittal Agro Industries is the one of the pioneers in desiccated coconut processing sector in India. The company has proved that a Desiccated Coconut (DC) unit in India can compete with international processors and get quality conscious international buyers to repose faith in Indian Desiccated Coconut. Thanks to the efforts put in by Vittal Agro Industries in assuring the international buyers that Indian DC quality is of international standards and today buyers are after Indian Desiccated Coconut.

Vittal Agro Industries was set up with the passion and vision to create the best desiccated coconut plant in India. Coconut Development Board gave ample support along with subsidy under the Technology Mission on Coconut. Till then, DC processing technology in India was behind the technology curve whereas other countries like Sri Lanka, Philippines, etc. had moved far ahead of the curve with the latest technology in processing.

Vittal Agro Industries invested in the latest technology and was instrumental in introducing a lot of new concepts in to the Indian DC industry like Gasifier, Stainless Steel Screw conveyors, Vibro Fluidized Bed Drier, Steam Blancher, Eco Friendly Turbine Ventilators, Metal Detector, Effluent Treatment Plant, Cold Storage, Coconut water extraction for beverage purposes, in house lab for quality control, Crate Washers, etc.

Vittal Agro Industries frequently impart training to workers in following better hygiene and sanitation practices. The entire plant is conceived keeping the best quality in mind and according to the specifications of ISO 22000 Food Safety Management System. Infact, Vittal Agro Industries became the first Desiccated Coconut Processor in the country to get ISO 22000 Food Safety Management System Certification from the Bureau Veritas Certification India Pvt. Ltd.

Vittal is the largest exporter of DC from India today. The company has built a brand known for quality and reliability and has earned a rich name for itself by adhering to its traditional values and principles in business. It is this quality that has converted a number of buyers in to loyal and repeated customers.

Each lot of desiccated coconut undergoes vigorous testing in the in house lab for meeting the microbial and physiochemical standards. The state of the art laboratory which is fully equipped with the latest equipments has a team of qualified and trained personnel doing all the required tests to ensure that the product meets the stringent quality standards.

The company sources the raw material from local area surrounding the factory at Thattummal near Kanhangad in Kasargod District in Kerala. A number of farmers from near and far bring their coconuts directly to the factory and take advantage of the direct buying price offered by the factory. The factory has become a boon to the local farmers who are assured of good price as well as immediate payment for their produce. This has resulted in a loyal customer base for the DC from Vittal Agro Industries.

The factory has a built up space in excess of 20,000 square feet and has been built in accordance to the requirements of the ISO 22000 Food Safety Management System. HACCP (Hazard Analysis at Critical Control Points) also forms an integrated part of this system. Preprocessing and final Processing areas are separated with access control to ensure process and product quality.

The byproducts in the process are coconut shell, coconut parings and coconut water. The factory has the facilities to convert these by products in to value added products like coconut shell charcoal, coconut chips (dried coconut parings) and refrigerated coconut water thereby ensuring huge value additions to byproducts.

Vittal recieving CDB award for the Best Coconut Processor from, Shri. Radha Mohan Singh, Agriculture Minister, Government of India.

Vittal Agro Industries, is a family run business under the leadership of two visionary brothers. Sathish Kamath who has an experience in the field of agricultural produce for more than four decades and Gokuldas Kamath, a visionary who has expanded the reach of the group in to various arenas and has played a very big role in expanding the business footprint of the Gajanana Group. They are ably assisted by the next generation - Guruprasad Kamath who manages the processing unit, Ganesh Kamath handles marketing and Santhosh Kamath provides technical support. The group is also involved in processing and marketing of food products like cashew nuts, almonds, walnuts, etc. The group which was mainly in to trading is now venturing into processing locally available agricultural products, coconut and cashew.

The factory was planned with a capacity to process 50000 coconuts per day and the factory now processes up to 120000 coconuts per day. The expansion plan is in the final stages to upgrade and expand the production to process 250000 nuts per day and make the plant compliant with Global Food Safety Initiative(GFSI). Plans are afoot to ensure that the expansion is completed in a few months with further addition in processing area and machinery with an aim to ensure further improvement in quality of the process and product. In recognition of the various achievements made for coconut sector. Coconut Development Board awarded Vittal Agro Industries with the Best Coconut Processor Award 2014.

For more details contact: Vittal Agro Industries, sales@vittalagro.com or guru@vittalagro.com. ■

Desiccated coconut - the profile

Desiccated Coconut Powder is obtained by drying ground or shredded coconut kernel after the removal of brown testa. It finds extensive use in confectioneries, puddings and many other food preparations as a substitute to raw grated coconut. In India the product is manufactured by units mainly scattered in Karnataka, Tamil Nadu, Kerala and Andhra Pradesh.

A study conducted by the Coconut Development Board has revealed that a growing consumer demand for desiccated coconut powder could be developed in the country by resorting to organized market promotion activities for the popularization of the product in consumer packs for household uses. The survey has also shown that desiccated coconut powder in consumer packs is acceptable not only in non-coconut producing states but also in traditional coconut growing states such as Kerala. From the survey it was revealed that a sizeable section of the middle class and upper class families residing in cities and towns in Kerala would prefer desiccated coconut powder, if readily available, to raw nuts.

Health Benefits of Desiccated Coconut

Desiccated coconut is rich in healthy saturated fats with no cholesterol and is also a good source of dietary fiber. Lauric acid, the medium chain fatty acid from the fat of the coconut, is having antiviral, antibacterial, and antiprotozoal properties. Capric acid, another of coconut's fatty acid is also found to have antimicrobial properties. These fatty acids are found in large amounts only in traditional lauric fats, especially from coconut. Recently published research has shown that natural coconut fat in the diet leads to a normalization of body lipids, protects against alcohol damage to the liver and improves the immune system of body. Coconut contains dietary fiber which passes through the digestive tract without being broken down or absorbed and is passed out of the body. Instead of contributing to health problems like starch and sugar, fiber promotes good health. Coconut is a natural low - carbohydrate, high - fiber food ideally suited for low carbohydrate diets. Coconut flour has been found in several studies to have a glycemic lowering effect, because coconut meat has simple carbohydrate content coupled with a high fiber, it yields a flour that is less disruptive to blood sugar levels. It is vegan and gluten free.

Food Safety Standards for Desiccated Coconut

As per FSSAI standards, Grated Desiccated Coconut means the product obtained by peeling, milling and drying the kernel of coconut (Cocos

nucifera). The product may be in the form of thin flakes, chips or shreds. The product shall be white in colour, free from foreign matter, insects, mould and rodent contamination. The product shall have pleasant taste and flavour, free from rancidity and any evidence of fermentation.

The product shall conform to the following requirements as per the food safety and standards regulations, 2011:

(i) Extraneous Vegetable matter:	Not more than 15 units/ 100 gm
(ii) Moisture (m/m):	Not more than 3.0 percent
(iii) Total Ash (m/m):	Not more than 2.5 percent
(iv) Oil Content (m/m):	Not less than 55.0 percent
(v) Acidity of extracted fat pressed	Not more than 0.3 percent as Laurie Acid (m/m)
(vi) Sulphur Dioxide	Not more than 50.0 mg/kg

List of Food Additives		
SI.No	Permissible Food Additive	Limit
1	Sulphur dioxide, Sodium/ Potassium/ Calcium Sulphite/ Bisulphate/ Metasulphite expressed as S02	50mg/kg maximum

Microbiological Requirements		
SI.No	Parameter	Limit
I	Total Plate Count	Not more than 40,000 per gm

Manufacturing Process

It is simple and well-established. Fully grown and matured coconuts of around one year are stored with husk for about a month to facilitate absorption of water and separation of coconut kernels from shell walls. After de-husking, shells are removed and brown portion (also known as Testa) is removed by scrapping it off and in this process around 12-15% of the kernel goes as paring which is further processed to obtain oil, and thus there is a ready market for this by-product. Subsequently, de-shelled coconuts are broken into pieces, washed and disintegrated in powder form. This powder is then dried in tray drier at about 80 -90°C and powder is stirred occasionally to ensure uniform drying. On cooling, it is passed through vibratory screen with different mesh sizes to segregate the powder according to mesh size. Finally, it is packed in moisture and oil-proof polythene-lined plywood boxes of 10, 25 or 50 kgs and even in retail packets of 200 / 400g. Recovery of desiccated coconut largely depends upon quality of coconuts. But on an average processing of 100 coconuts gives around 10 kg of coconut powder. By-products like parings and shell can be sold in the market.

According to IS 966:1999, DC is produced by a mechanical process of disintegrating, cleaned and

Process flow chart of desiccated coconut

List of Plant and Machinery	
Sl.No	Item
1	Coconut de shelling machine
2	Brown skin removing machine
3	Washing Unit
4	Whole nut inspection conveyor
5	Disintegration Unit
6	Blanching Unit
7	Dryer with pre drying circuit and dust collection system
8	DC powder cooler
9	Lump breaker
10	Vibro sieve
11	Intermediate Conveyors

dried pieces of pared kernel of fully matured and fresh coconut. The product should be natural white in color. It shall have characteristic taste, odor and flavor. It shall be free from cheesy, smoky, musty or any other objectionable odors, fungus and insect infestation. It shall be crisp, free from rancidity and not show fat sweating. DC is categorized into three types based on the particle size and are as follows:

- Fine – if size of particle is between 1.40mm and 1.00 mm or if it is retained on 1.00mm IS test sieve.
- Medium- If size of particle is between 1.70 mm and 1.40 mm or if it is retained on 1.40 mm iS sieve.
- Coarse – If size of particle is more than 1.70 mm or if it passes through 1.70 mm IS test sieve.

Yield of the product is 1 tone from 10,000 coconuts.

Composition of the Product		
Sl. No	Item	Quantity
1	Moisture	1.3-2.5%
2	Protein	6.0-6.6%
3	Oil	68-72%
4	Carbohydrate	18-20%
5	Crude fibre	4-6% Source* - Tropical Foods, Chemistry and Nutrition, Volume 2, George E Inglett

Low fat Desiccated Coconut

Desiccated coconut is of two types: High fat and low fat. High fat means the desiccated coconut

> "CDB under the TMoC programme extends financial assistance for establishing DC units."

Capital Investment		
Components	Capacity	
	15,000 coconuts per day	25,000 coconuts per day
	(Rs. in lakhs)	
Land (min 50 cent)	Own/Leased	Own/leased
Building & Civil	35.00	45.00
Works		
Plant & machinery	67.00	87.00
ETP	5.00	5.00
Electrification	4.00	5.00
Generator	10.00	10.00
Pre-operative expenses	0.67	0.87
Working capital margin	8.00	13.00
Total	129.00	165.87

powder produced without removal of coconut milk. Low fat desiccated coconut powder is produced as the byproduct of coconut milk/VCO/ DC units and is having a fat percentage upto 38-40%. It is a good source of dietary fiber. Low fat DC is used for the manufacturing of coconut flour (Annexure A) and dietary fiber.

CDB Scheme for Promotion of Coconut Industries

Coconut Development Board under Technology Mission on Coconut extends financial assistance to the limit of 25% of the eligible project cost limited to Rs. 50 lakhs per project. Under this scheme, CDB has supported 91 desiccated coconut powder manufacturing units with a processing capacity of 909.45 million nuts per year. For technical enquiries and for availing subsidy, please send email to cdbtech@gmail.com. For export related enquiries, please send email to epccdb@gmail.com ■

Amazing Key Benefits of Desiccated Coconut

There are so many fruits, desiccated coconut is much less popular. Dessicated coconut produced from the shredded coconut kernel after remaining the brown testa contains good and high nutritious value and it's always better to add dried coconut into daily diet.

Strengthens Bones:

Desiccated coconut can strengthen your bones and ligament tissues. To have better strong bones it's good to consume desiccated coconut based products.

For Healthy Brain

Desiccated coconut makes brain healthier. Myelin is good for brain health and consumption of dried coconut help to increase the production of those elements in your brain. Thus helps to improve brain health.

Help to create Healthy Recipies

Many healthy recipes can be created by using this dried coconut. Most of the coconut based recipes are delicious. It's always to better to have dried coconut in your pantry.

Help to strengthen Connective Tissue

Desiccated coconut got higher mineral content. These minerals help in improving the necessary tissues in our body.

Desiccated coconut Contains High Minerals

Desiccated coconut contains high minerals. This reduces the mineral deficiency which leads to some diseases such as osteoporosis and arthritis. Most of the coconut based products are good to use because of its higher mineral content. It contains Riboflavin, dietary fiber and necessary minerals to our body such as calcium, copper, magnesium and selenium.

For Better Cardiovascular Health

Consumption of desiccated coconut lowers cholesterol level of blood. Desiccated coconut strengthens and promotes the cardiovascular health of our body. So using dessicated coconut would be a great food base alternative to improve cardiovascular health.

American Heart Association®

Beware of more **misinformation** from the AHA on coconut oil & saturated fats

Dr. Anthony C. Pearson, MD*

Coconut Oil: Poster Child for Dietary Fat Confusion

Coconut oil is a microcosm of the dietary confusion present in the U.S. On one hand a Coconut oil Google search yields a plethora of glowing testimonials to diverse benefits: Wellness Mama lists 101 Uses for Coconut Oil and Authority Nutrition lists 10 Proven Health Benefits.

On the other hand, the American Heart Association (AHA) and the USDA's Dietary Guidelines For Americans warn us to avoid consuming coconut oil because it contains about 90% saturated fat (SFA) which is a higher percentage than butter (about 64% saturated fat), beef fat (40%) or even lard (also 40%)

In many respects, the vilification of coconut oil by federal dietary guidelines and the AHA resembles the inappropriate attack on dairy fat and is emblematic of the whole misguided war on dietary fat. In fact, the new AHA advisory cherry-pick the data on dairy fat and cardiovascular disease in order to support their faulty recommendations for choosing low or nonfat dairy.

The AHAs simple message to replace all saturated fats in your diet with poly unsaturated fats (PUFAs) or monounsaturated fats (MUFAs) is flawed because: all saturated fats are not created equal. The kinds of saturated fats in coconut oil differs markedly from both dairy SFAs and beef SFAs. Some SFAs may have beneficial effects on blood lipids, weight, and cardiovascular health.

The types of non SFAs in vegetable oils differ markedly and may have differential effects on cardiovascular health.

Cherry-Picking Data

The new AHA presidential advisory doesn't include this study or data from the Sydney Heart Study, another study with negative results for substituting PUFAs for SFAs.

As Gary Taubes pointed out in a post for Larry Husten's cardiobrief.org blog, the AHA experts cherry-picked four "core trials" that agreed with their hypothesis and excluded the ones that don't agree.

They do this for every trial but the four, including among the rejections the largest trials ever done: the Minnesota Coronary Survey, the Sydney Heart Study, and, most notably, the Women's Health Initiative, which was the single largest and most expensive clinical trial ever done. All of these resulted in evidence that refuted the hypothesis. All are rejected from the analysis. The AHA experts have good reasons for all of these decisions, but when other organizations – most notably the Cochrane Collaboration – did this exercise correctly, deciding on a strict methodology in advance that would determine which studies to use and which not, without knowing the results, these trials were typically included.

All Saturated Fats Are Not Created Equal!

Saturated fats are divided into various types based on the number of carbon atoms in the molecule. Depending on length, they differ markedly in their metabolism, absorption and effects on lipid profiles. The major SFA in coconut oil, lauric acid, has a 12 carbon chain and is thus considered a medium chain fatty acid (MCFA).

The AHA advisory makes a cursory attempt to address the huge hole in their logic primarily relying on a meta-regression analysis published in 2003 by Mensink, et al.,

The Mensink meta-regression analysis determined the effects on blood lipids of replacing carbohydrates with the individual saturated fatty acids that are in common foods, including lauric, myristic, palmitic, and stearic acids. Lauric, myristic, and palmitic acids all had similar effects in increasing LDL cholesterol and HDL cholesterol and decreasing triglycerides when replacing carbohydrates

The common individual saturated fats raise LDL cholesterol. Their replacement with monounsaturated or polyunsaturated fats lowers LDL cholesterol. Differences in the effects of the individual fatty acids are small and should not affect dietary recommendations to lower saturated fat intake.

Lauric acid greatly increases total cholesterol, but much of its effect is on HDL cholesterol. Consequently, oils rich in lauric acid decreases the ratio of total to HDL cholesterol. Myristic and palmitic acids has little effect on the ratio and stearic acid reduces the ratio slightly.

The differences in the effects of the individual fatty acids are not small they are quite significant if we look at the totality of the effects on lipids relevant to cardiovascular disease. In their discussion, Mensink, et al go on to say: Our results emphasize the risk of relying on cholesterol alone as a marker of CAD risk. Replacement of carbohydrates with tropical oils markedly raises total cholesterol, which is unfavorable, but the picture changes if effects on HDL and apo B are taken into account.

Coconut Oil: The Bottom Line

After all is said and done, it would appear that coconut oil, despite coming from a vegetable, resembles dairy fat in many ways.

It is more likely than not that coconut oil, like dairy fat, reduces your chances of obesity and heart disease, especially when compared to the typical American diet of highly processed and high carbohydrate foods.

Although containing lots of saturated fat, the SFAs in coconut oil are drastically different from other dietary sources of SFA. The medium chain fatty acids like lauric acid which make up the coconut are absorbed and metabolized differently from long chain fatty acids found in animal fat.

The only explanation for dietary guidelines advising against coconut oil and dairy fat is the need to stay “on message” and simplify food choices for consumers, thus continuing the vilification of all saturated fats.

We deserve good scientific studies proving without a doubt that these drastic changes in diet are truly helping:

**Dr. Anthony C. Pearson, MD - St. Luke's 222 S Woods Mill Rd #500n, Chesterfield, MO 63017, USA*

Source : Healthy Ways News letter (14/2) by Dr. Bruce File.

A Half-Truth is Not the Whole Truth

The AHA Position on **Saturated Fat**

Dr. Fabian M. Dayrit

Professor, Ateneo de Manila University, Philippines

Chairman, Scientific Advisory Committee for Health, Asian and Pacific Coconut Community

This second in this series of papers will present the biases in the American Heart Association's 2017 Presidential Advisory with respect to saturated fat. Although important differences in the metabolic properties of specific SFA have been known since 1960s, the AHA still considers all SFAs as one group having the same properties. There is abundant research available that supports the designation of C6 to C12 fatty acids as medium-chain fatty acids (MCFA). This is particularly relevant to coconut oil, which is made up of about 65% MCFA. Ignoring the evidence, AHA simply labels coconut oil as SFA. The AHA promotes half-truths, not the whole truth.

On June 16, 2017, the American Heart Association issued its AHA Presidential Advisory which repeated its recommendation to "shift from saturated to unsaturated fats" (Sacks et al., 2017). While this advisory did not present any new data, it provided a re-analysis of old data which selectively rejected some studies which it claims did not satisfy "rigorous criteria for causality," while reinforcing those which were favorable to its conclusions.

The first paper in this series (published in June 2017 issue of Indian coconut Journal) showed that the scientific basis upon which the AHA made its recommendations is flawed and the Dietary Guidelines for Americans, which has been recommending a low-saturated fat diet for 35 years, has made Americans obese even as heart disease – the supposed concern of the AHA – has remained the top health problem.

This second article is focused on "saturated fatty acids," the fat that AHA wants us to minimize. This article analyzes the 2017 AHA Presidential Advisory and provide counter evidence from the scientific literature, including clinical studies, to show that much of the confusion that we have today regarding the role of these fats in a healthy diet stems from the selective use of scientific information regarding saturated fat. The 2017 AHA Presidential Advisory provided only half the truth on saturated fat.

SFA, MCFA and LCFA

Saturated fatty acids (SFAs) generally refer to the following linear carboxylic acids: caproic ($C_5H_{11}CO_2H$, C6), caprylic ($C_7H_{15}CO_2H$, C8), capric ($C_9H_{19}CO_2H$, C10), lauric ($C_{11}H_{23}CO_2H$, C12), myristic ($C_{13}H_{27}CO_2H$, C14), palmitic ($C_{15}H_{31}CO_2H$, C16:0), and stearic ($C_{17}H_{35}CO_2H$; C18:0). SFAs share the same structural features, but differ in their molecular size. Because of the apparent similarity in their chemical structures, SFAs are often assumed to possess the same biochemical and physiological properties. This is not true.

Coconut oil is an important chemical feedstock for the oleochemical industry . It is hydrolyzed and separated into its individual fatty acids. Lauric acid (C12), the main component of coconut oil, has the highest commercial value and is used in manufacture of various surfactants. There was a need to find applications for the other fatty acids. In the 1960s, a new synthetic group of fats was developed – "medium-chain triglyceride" (MCT) – which was made up mainly of C8 and C10. This commercial mixture was later called "MCT oil" and the main component fatty acids, C8 and C10, were called "medium-chain fatty acids" (MCFA). Initial feeding studies on rats showed that MCT oil was non-toxic and did not lead to weight gain compared with lard (Senior, 1968). Human clinical trials later showed that MCT oil was useful for patients with lipid disorders and for weight loss and it became commercially available in mid-1960s (Harkins & Sarett, 1968).Since then, MCT oil has been widely used in clinical practice as a special dietary oil and has been classified by the US FDA as GRAS (generally recognized as safe) (FDA, 2012). Because of its wide commercial availability and safety, medical researchers use MCT oil in their research. Consequently, most medical researchers consider MCFA to includeC8 and C10 only; by exclusion, they use the term "long-chain" fatty acids (LCFA) to mean the longer SFAs, C12 and longer.

This historical account clearly shows that the classification of MCFA as C8 and C10 was based on the commercial availability of MCT oil and not on scientific considerations, and its wide use in clinical research reinforced this. However, based on biochemical and physiological properties, the classification of MCFA should include the fatty acids from C6 to C12.

Numerous researchers consider MCFAs to include the fatty acids from C6 to C12 based on their metabolic properties (Bach & Babayan, 1982; St. Onge & Jones, 2002; McCarty & DiNicolantonio, 2016; Schonfeld & Wojtczak, 2016; TMIC, 2017). MCFAs possess special properties that differentiate them from LCFAs. This section will highlight some of the special characteristics of MCFAs in general, and C12 in particular, will show why using only the single category of "saturated fatty acid" is a half-truth.

SFAs in various fats and oils

All biological organisms and cells utilize different fatty acids to produce lipids that are characteristic of the organism and cell type to fulfill its structural or functional requirements. The fatty acid profiles of the various vegetable oils are characteristic of the plant source (Codex, 2015). Coconut oil has a characteristic fatty acid profile that differs from other vegetable oils in terms of its fatty acid profile: almost 50% is C12, about 65% is C6 to C12, and 92% is saturated. In contrast, the fatty acid profiles of all other vegetable oils start mainly with C16 and contain a significant proportion of unsaturated fatty acids. For example, soybean oil and corn oil both contain over 50% C18:2 (linoleic acid, an omega-6 fatty acid) and over 80% total unsaturated fat. Even animal fats, such as beef fat and lard, contain a substantial amount of unsaturated fat. For example, both beef fat and lard contain about 60% total unsaturated fatty acids even though these are

often referred to as "saturated fat". Clearly, the fatty acid composition of coconut oil is very different from those of animal fats, including butter.

Another feature that sets the group of MCFAs (C6 to C12) apart is that they are not generally present in human abdominal fat and liver fat, and they are not constituents of serum lipids, whether as triglycerides or phospholipids. Analysis of fats in the liver using mass spectral imaging analysis did not detect any MCFA; the smallest fatty acid found was C14 (Debois et al., 2009). This is consistent with the claims that MCFAs (C6 to C12) comprise a separate category from LCFA and that the use of "SFA" as a common label for this group is incomplete.

Another distinguishing characteristic of the group of MCFA (C6 to C12) is that they are rarely found attached to cholesterol as fatty acid ester derivatives. Plasma cholesterol is attached to long chain saturated and unsaturated fatty acid esters, in particular C16:0, C18:0, C18:1, C18:2, and C20:4 (AOCS, 2014).That

is, LCFA and PUFA are involved with the circulation of cholesterol around the blood stream and cholesterol deposited in arterial plaques, not MCFA.

"Saturated fat" and "animal fat" in the scientific literature

The vast majority of epidemiological studies, starting from Ancel Keys (1957) to the present, have failed to distinguish MCFA and LCFA and make their conclusions using the gross category of SFA. Unlike PUFAs, which are differentiated as omega-6 and omega-3, most epidemiologists, except those who study coconut oil in the diet, ignore the differences between MCFA and LCFA. In fact, most doctors and nutritionists commit the error of lumping animal fats and coconut oil into one category. Is it any wonder then that the wrong dietary advice has been made for coconut oil and C12?

There are, however, a few papers that have specifically addressed C12. In 2003, Mensink and co-workers combined the results of 60 controlled trials into a single analysis (called a meta-analysis) and calculated the effects of the amount and type of fat on the ratio of total cholesterol to HDL (high-density lipoprotein), as well as to lipids. They reported that C12 increased HDL so that the net effect was to decrease the ratio of total cholesterol to HDL, a beneficial result. On the other hand, the LCFAs C14 and C16:0 had little effect on the ratio, while C18:0 reduced the ratio slightly. This is certainly a favorable result for C12.

Interestingly, the 2017 AHA Presidential Advisory also disposed of the beneficial properties of HDL without adequate proof, proclaiming that now CHD would be all about LDL: "...changes in HDL-cholesterol caused by diet or drug treatments can no longer be directly linked to changes in CVD, and therefore, the LDL-cholesterol-raising effect should be considered on its own."

Since HDL is generally considered a standard lipid indicator, it is incumbent upon the AHA to provide definitive evidence to support its claim that HDL is now useless as a predictor of CHD.

Today, several types of LDL particles are known. LDL particles can be small and dense LDL (sdLDL) or large and buoyant (lbLDL). sdLDLis more susceptible to oxidation producing oxidized LDL (oxLDL). Thus sdLDL is more atherogenic and has been shown to be a strong predictor of CHD, while large buoyant LDL is not (Toft-Petersen et al., 2011; Hoogeveen et al., 2014).

In a 10-year study in Finland on 1,250 subjects, the various types of lipoproteins – LDL, HDL, and oxLDL – were measured. The study concluded that oxLDL, in proportion to LDL and HDL, was a strong risk factor of all-cause mortality independent of confounding factors (Linna et al., 2012). Furthermore, it has also been reported that the ratio of triglyceride to HDL is also a predictor for coronary disease (da Luz et al., 2008). If this is the case, HDL should remain an important lipid parameter, contrary to the AHA proclamation.

In the case of LDL, the absence of data onsdLDL and oxLDL in early studies involving LDL measurements makes their conclusions questionable. Correlations which have been made between LDL and CHD cannot therefore be considered reliable.

Conclusion

The warnings against saturated fat started with Ancel Keys. Keys never showed any appreciation for the physiologic differences between medium-chain fat and long-chain fat. The AHA has adopted this position to ignore the distinction between MCFA and LCFA despite numerous advances in their science. Detailed comparison of the fatty acid composition shows that coconut oil is very different from animal fat and studies that assume that they are similar are therefore in error. These may be one of the reasons why the Dietary Guidelines have not worked. ■

To this conclusion, we can apply the warning that Benjamin Franklin once made:

"Half a truth is often a great lie."

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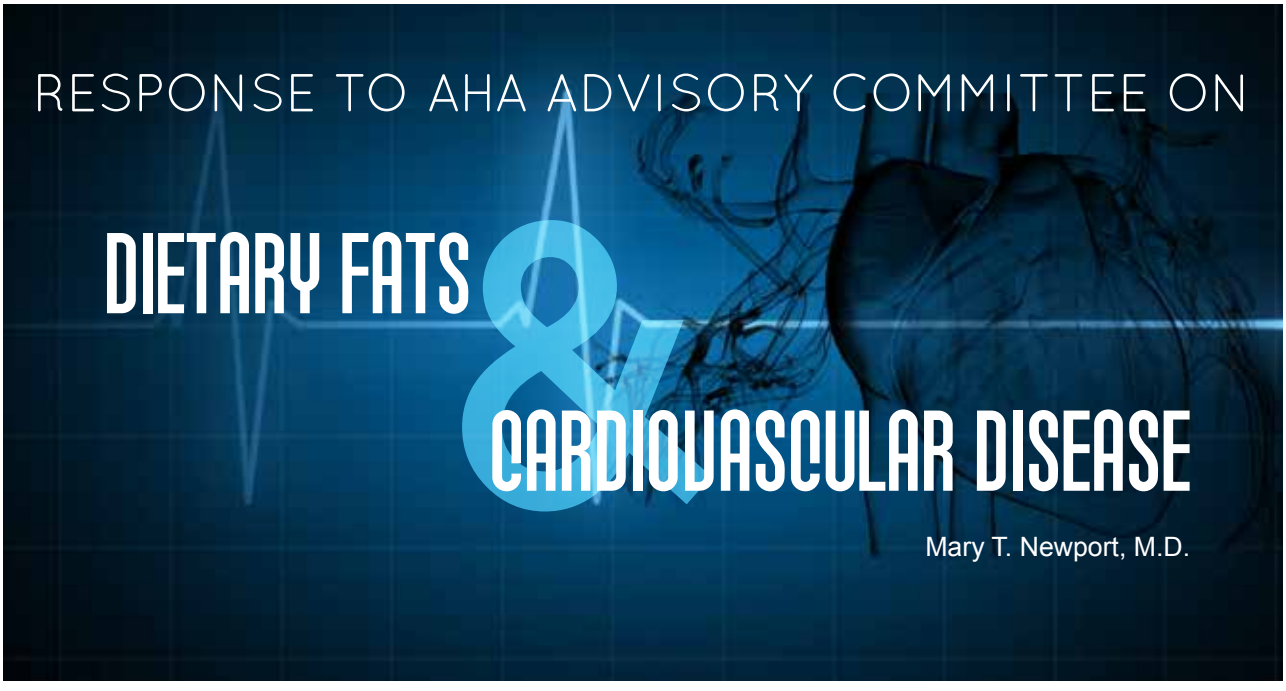
The media has irresponsibly taken viral a fragment of information purporting that coconut oil may be bad for your heart from an article published in the medical journal "Circulation" 2017, 135:e1-24, as a presidential advisory committee report from the AHA, "Dietary Fats and Cardiovascular Disease". The four "core studies" this committee relied on were all conducted in the 1950s, were relatively small groups of men only in three of the four studies, were conducted in populations that almost certainly were not consuming coconut oil on any regular basis, and were studies comparing diets with animal saturated fats to diets with polyunsaturated fats. Animal and human fat is well known to store hormones, pesticides, antibiotics and other environmental substances, which could be a factor in heart disease, whereas vegetable fats such as coconut oil would not be so likely to contain these potentially harmful substances. The authors do not mention whether age and smoking were controlled in these studies; smoking, which was very prevalent in the 1950s compared to the 2010's is a major contributor to heart disease. The raw numbers of how many people in each group had cardiac events was not presented, making the summaries difficult to evaluate. The clincher in this article is that they state on page e13, under the section on coconut oil, "Clinical trials that compared direct effects on CVD [cardiovascular disease] of coconut oil and other dietary oils have not been reported." They rely on studies of individual saturated fatty acids that show a miniscule increase in LDL (co called "bad") cholesterol but rationalize away a similar small increase in HDL ("good")and an improved LDL to HDL ratio. For example, lauric acid (50% of coconut oil) resulted in a less than 1 mg/dl point increase in both LDL and HDL cholesterol, with typical LDL values ranging from less than 100 to 160 mg/dl. Could a change of less than 1 mg/dl really have that much impact? In addition, the problem here is that natural fats such as coconut oil and even lard do not come as individual fatty acids but rather combinations of many fatty acids which may balance each other out. Completely ignored in this report are the saturated fats in coconut oil known as medium chain triglycerides that could balance out the longer chain fats. Coconut oil also contains some mono- and polyunsaturated fats. One of the important details that the AHA is missing here is that 70% of the saturated fats in coconut oil are medium chain triglycerides (C6 through C12, lauric acid) which are

> "Saturated fats in coconut oil are medium chain triglycerides which are either converted to ketones or burned immediately as fuel by muscle and other organs and not stored as fat."



either converted to ketones or burned immediately as fuel by muscle and other organs and not stored as fat. Lauric acid has some properties of medium chain and longer chain fatty acids. Ketones come from breakdown of fat and provide an alternative fuel to the brain and most other organs during starvation or fasting or to cells that are insulin resistant. In a recent study conducted in Japan, lauric acid was found to potently stimulate ketone production in astrocytes in cultures; astrocytes are brain cells that nourish other brain cells. By comparison, butter, lard and animal fat contain minimal medium chain triglycerides and they are not found in soybean, olive, corn, safflower and most other oils. There are hundreds of studies of potential benefits of coconut oil; for example, lauric acid, which is a medium chain triglyceride and about 50% of coconut oil, is antimicrobial - there are numerous studies showing that lauric acid kills many bacteria, viruses, fungi like candida and protozoa. A few small cholesterol studies looking at coconut oil were conducted decades ago in animals or a few men over short term and used hydrogenated coconut oil - any hydrogenated oil will increase cholesterol. Also, the diets were deficient in omega-3 fatty acids which can also increase cholesterol levels. There are studies of entire populations for whom coconut oil provides 1/3 to 2/3 of the diet showing that they were of normal height and weight, had normal blood pressure, triglycerides and cholesterol levels at all ages. The committee surmises that people who eat saturated fats likely have other bad eating habits without any proof. These days, the people who embrace coconut oil are likely embracing healthier foods as well and a healthier lifestyle in general and eating fish and/or taking omega-3 fats, which weren't on the radar in the 1950s when the so-called "core studies" for this report were conducted.

The folks in the AHA and other organizations who perpetuate these myths about coconut oil need to really do their homework and learn more about medium chain triglycerides and study the other beneficial effects of coconut oil, which they choose to ignore. The bottom line that came out of their lengthy report is that "coconut oil is bad for your heart", which has now been perpetuated by media who jumped on this conclusion that is not even based on direct research of coconut oil and heart disease. This message has gone viral worldwide. The impact of this could take a devastating toll on the economies of countries that produce coconut oil, mostly made up of individual farmers and their families trying to make a living. These economies were devastated in the 1960s and have been slowly recovering from the initial similar AHA statement on saturated fats in 1961 based on the same four "core studies". It is irresponsible and unconscionable for this advisory committee to make such sweeping claims without direct proof that coconut oil causes heart disease.

For more information on coconut oil and ketones please Dr. Mary New Port's website at www.coconutketones.com.

Source: The Healthy Ways News letter (14/2) by Dr. Bruce File ■

Workshop on Replanting & Rejuvenation held in AP

The Department of Horticulture, Govt. of Andhra Pradesh conducted a workshop on new Scheme 'Rejuvenation & Replanting of Coconut Gardens' on 21.07.2017 at Meeting Hall, SC Corporation, Zilla Parishad, Guntur.

Shri. Chiranjiv Choudhary IFS, Commissioner of Horticulture, AP chaired the meeting. Dr. Ch. Padmavathi, Deputy Director of Horticulture welcomed the gathering. Shri. Chiranjiv Choudhary IFS released a Telugu pamphlet on the Scheme-Replanting & rejuvenation. While releasing the pamphlet, he called up on the implementing officers to expedite the base line survey in a farmer participatory manner by involving the FPOs formed in the State. The Scheme shall be implemented in the targeted project areas so as to eradicate the diseases affecting the coconut plantations

and also to rejuvenate the existing plantations by following the recommended scientific practices.

Shri Jayanath R, Deputy Director (*I/C*), CDB, State Centre, presented the details and modalities of implementation of scheme. All the Assistant Director of Horticulture, Horticulture Officers of the major coconut growing districts, Chairman of CPCs formed in A.P and Field officers of CDB attended the meeting. An interactive session was also arranged for the officials.

CDB promotes Coconut Based Integrated Farming to boost coconut production

R. Jnanadevan
Deputy Director, Coconut Development Board, Kochi -11

Coconut Based Integrated Farming System (CBIFS) is an economically sustainable system recommended by research which supports farmers to realize more income from coconut holdings. In CBIFS coconut recorded higher yield. Coconut mono-cropping is an inefficient land management system of low productivity and poor economic returns. There is ample scope for integration of companion crops and other animals in coconut garden for increasing income and providing employment generation under the CBIFS. Intercropping has proven to be the best option for maximizing land use in coconut plantation. Coconut Palms maintained under CBIFS receives Integrated Nutrient Management (INM) ie, combined application of the organic manures and inorganic fertilizers, Integrated Pests and Disease Management so as to extract potential yield from the crops . The annual labour requirement can also be enhanced to a maximum of about 780 - 830 man days in one hectare CBIFS coconut plantation per year whereas the man days required for mono-cropped coconut garden is 150 man days. In CBIFS, not only the farm family is getting employment round the year but also it provides man days for outside labour.

With the above cited scientific background of CBIFS the Coconut Development Board (CDB) has been implementing a massive programme Integrated farming in coconut holdings for productivity improvement. It is one of the major programmes of CDB now being implemented in 17 States and 3 Union Territories in the country. The programme aims to promote adoption of INM/IPM practices and coconut based farming system in coconut garden so as to reduce the gap between the potential expected income and the present income farmers are getting from their coconut holdings.

Main component of the scheme integrated farming in coconut holdings for productivity improvement implemented by the Board 'Laying out of Demonstration Plots' (LoDP) is a farmer participatory technology transfer programme implemented on cluster basis with the active participation of farmers. Besides considering the importance of use of organic manures in coconut garden financial support is also extended for establishing organic manure production units (vermi compost/coir pit compost units) in coconut garden Financial assistance @ Rs.35,000/- per hectare is extended under the scheme Laying out of Demonstration Plots for adoption of INM/IPM/ Coconut based farming system for a period of two years. A major portion of grant in aid received by the Board from the Govt. of India is being utilized by the Board under this scheme to supply critical inputs to the farmers for adoption of INM/IPM/CBIFS. Major components of LoDP scheme are:

1. Demonstraion of balanced fertilizer application including green manure application.
2. Location specific inter/mixed cropping.
3. Community based Plant protection.
4. Use of Agricultural implements/machineries for Community Based Operations (CBO).

1. Demonstration of balanced fertilizer application including green manure application.

Coconut is a perennial crop that removes large quantity of nutrient to the above ground parts continuously from a limited volume of soil around the palm throughout its existance. Studies conducted by research stations recommend that most of the soils where coconut is growing continuously shows deficiency of nutrients and affect the crop yield unless regular manuring is carried out every year for replacing the nutrients removed. Once the seedlings are planted in the main field manures and fertilizers are to be applied regularly to get sustainable supply of nutrients to the growing palm. Integrated nutrient management involving application of organic and

inorganic manures is the best method recommended for giving balance dose of nutrients to the palm. The coconut palm at a production level of 50 nuts per year removes 500 g Nitrogen, 340 g Phosphorus, 1000 g Potash and 180 g Magnesium from the soil every year. In addition to the removal by coconut palm, soil nutrients also can be lost by runoff, leaching erosion and uptakes by weeds. This causes gradual decline of nutrients in the soil and in turn results in low yield. Therefore soil in coconut plantation should be enriched with nutrients by regular application of recommended dose of fertilizers and manures. Coconut Development Board under the LoDP programme provides the inorganic fertilizers or organic manures to the farmers to supplement the adoption of INM for a period of two years. Inorganic fertilizers such as Urea @ 1Kg per palm, Rock Phosphate or Super phosphate @ 1.5 Kg per palm, Murate of Potash @ 2 Kg per palm, Magnesium Sulphate @ 0.5 to 1 Kg per palm and Borax @ 50 – 100 g per palm annually as a part of adoption of INM practices. Besides in areas where soil acidity is a major problem lime/Dolomite @ 1.0 Kg/ palm is also supplied to the farmers free of cost under the scheme. Major portion of subsidy (60%) under LoDP component is utilized for supply of these critical inputs to the farmers. In areas where farmers prefers organic farming, good quality organic manure is supplied to the farmers utilizing the financial support under the scheme. In order to improve the organic matter content of soil, green manure seeds are also supplied to farmers under the scheme.

2. Promoting Location specific inter/mixed cropping

Optimum method of inter/mixed cropping in coconut garden is popularized under this component. Suitable crop combinations are suggested depending on the farmer groups preference, his resource endowment and prevailing agro ecological features of the locality. Intercrop planting material suitable for a location is arranged for supply to the farmers for raising on cluster basis under the LoDP programme. This would help to increase the income and profit from coconut garden, increases sunlight use efficiency, maximize resource utilization, improves soil fertility, suppress weed growth and reduces risk of depending on crop(coconut) for income and also provides food security to the farming community.

3. Promoting Integrated Pest and Disease Management

Need based integrated pest management by adoption of cultural, biological and chemical methods are essential in coconut gardens to maintain the productivity. In many cases parasites and predators are helpful in managing the pest. Promoting Integrated Pest and Disease Management on community basis is another major component programme under LoDP in pest/disease affected areas. Support is extended by way of supplying Plant Protection (PP) Chemicals, Bio-control agents for adoption of IPM practices for management of pest and diseases. Community based successful bio-control of the pest, coconut black headed caterpillar outbreak in East Godavari District of Andhra Pradesh is one of the success stories under LoDP. Combined and collaborative extension efforts of CDB, Department of Horticulture and Coconut Producer Societies technically supported by Horticultural Research Station, Ambajipeta, Dr YSRHU led to successful suppression of outbreak of black headed caterpillar in the LoDP villages of Allavaram Mandal of East Godavari district of Andhra Pradesh.

4. Community Based Operations

Financial support is extended for purchase of agricultural machineries and equipments for use on community basis under the scheme. Pump sets for use on community basis is also supplied with financial support under the scheme for promotion of irrigation during summer months. Equipments needed for plant protection operations, cultural practices and agricultural operations are considered under the scheme for extending the financial support on community basis. The ownership of the machineries/ equipments purchased shall be vested with the cluster/society and made available to the members on need basis.

CDB has been implementing the integrated farming scheme since the last ten years. The scheme is implemented directly by the Board on cluster basis through FPOs and also through the Department of Agri./Horti. of the concerned State Governments. Unlike other development programmes, the scheme is implemented with the active participation of farmers, development officers and students of nearby research stations of SAUs/ICAR Institutes. Implementation of scheme would help to improve the nutritional status and health of coconut palm which was reflected in the production and productivity of coconut in the country. Implementation of this scheme would help the coconut sector not only in terms of increase in income from unit area but also by way of sustained employment. Finally the scheme also would help to improve the livelihood of a vast majority of small and marginal coconut farmers in the country. ■

Cowpea:

A potential nutrient source in coconut garden

Coconut – Kalpavriksha is one of the most important plantation crops in India. Large scale coconut cultivation is confined to the four southern states viz, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh (>90% area). It is grown in moderate to high rainfall areas, in a wide range of soil types. In coconut gardens, palms are widely spaced at 7.5 m x 7.5 m to maintain canopy coverage, whereas in the ground the maximum root activity is only up to a radius of 1.8 m around the base of the palm. Thus nearly 75% area is not effectively utilized by the palm. When coconut is grown as sole crop, the unutilized areas are vulnerable to soil erosion leading to loss of fertile

> **Growing cowpea is an excellent medium for resource conservation and weed suppression in coconut gardens.**

P. Subramanian, R. Surekha, V. Selvamani and Ravi Bhat
ICAR- Central Plantation Crop Research Institute, Kasaragod- 671 124, Kerala, India

Fig : 1. Cowpea grown in interspaces of coconut

top soil. Besides, there will be more weed growth in the basin and interspace (Fig.2). There are many alternative ways to effectively utilize the area and avoid soil and nutrient loss viz., adoption of cropping system, mulching etc,. Green manuring is one such alternative which acts as cover to check soil erosion, replenishes the soil nutrients as well as suppresses the weed growth.

Green manuring is growing of short duration crops in the field and incorporating them into the soil after sufficient growth. Cowpea, sesbania, sun hemp, dhaincha, pillipesara, cluster bean, horse gram etc. are some of the efficient and economically viable green manure crops. Cover crops should grow rapidly to cover soil surface and suppress the weed growth under prevailing soil and climatic condition without competing with the main/subsistence crop for the available resources. It should produce more quantity of green/dry mass and should have favorable residual effect on subsequent intercrops. Leguminous crops in general play a very important role in performing multiple functions that include improvement in soil nutrient content, organic matter addition to soil and soil conservation as well as enhancement of microbial biomass and enzymatic activity in soil.

Cowpea

Cowpea (Vigna unguiculata L.) is an annual short duration leguminous crop which can be used as green manure in coconut ecosystem because of its important features like moderate shade tolerance, quick germination, ease of establishment, profuse nodulation, low moisture requirement and robust growth. The plant performs well in a wide variety of soil types. It performs better in soils with a pH range of 5.6 to 6.0. Being a legume, when the biomass of the cowpea is incorporated into the soil, it replenishes soil fertility and improves the soil structure by adding organic matter to the soil. Further, as it covers the ground quickly it protects soil from erosion. Since, coconut productivity is closely related to the soil organic matter and availability of nutrients in soil, any improvement in these parameters directly influence the productivity. Therefore, it is essential to maintain the soil organic matter and nutrients either by recycling of biomass or application of fertilizers. Maheswarappa et al., (2003) reported that cowpea grown in coconut basin as green manure crop in the integrated nutrient management system played an important role in sustaining soil fertility and coconut yield.

Biomass yield

At ICAR- CPCRI Kasaragod research farm,

cowpea was grown as a green manure crop in coconut interspaces under red sandy loam and coastal sandy soil during the monsoon season. The field was prepared by a thorough ploughing with a disc plough in the month of June. Cowpea seeds were sown with a seed rate of 50 kg/ha through broadcasting and covered with rotovator at the onset of monsoon. The seeds germinated within 48 hours. The crop was grown under rainfed condition since this time coincides with south west monsoon in west coast region. From one hectare coconut garden (monocrop) interspaces, 11.0 and 7.7 tons of fresh biomass was obtained in red sandy loam soil and coastal sandy soil respectively. It was observed that the accumulation of fresh biomass varies depending upon the soil type. The red sandy loam soil accumulated more biomass when compared to coastal sandy soils due to the poor physico-chemical properties of coastal sandy soils. However, in situ availability of biomass is highly helpful to improve the physical properties of the soil over the period of time. Earlier studies have also shown that, the effect of green manuring varies according to the original character of the soil. When the cowpea reaches 50% flowering stage (60-70 DAS), the biomass needs to be incorporated by ploughing.

Nutrient supplying potential

Nutrient analysis of above and below ground biomass of cowpea indicated variability in nutrient composition. The above ground biomass of cowpea grown under coastal sandy soil recorded NPK content in the ratio of 3.02:0.27:2.47, while in red sandy loam soil it was about 2.93:0.27:2.46. The below ground part of cowpea biomass showed NPK content of 1.75:0.2:1.33 and 1.76:0.2:1.67 in sandy and red sandy loam soil respectively. This is mainly because cowpea roots penetrate deep into the soil and absorb nutrients from deeper layer and once incorporated in soil the same can be utilized by the intercrops which have shallow rooting system. Cowpea can produce eight feet taproot in roughly eight weeks (Clark, 2007). Thus, by incorporating cowpea in the surface soil, it will

be possible to bring back the nutrients mainly, potash and phosphorus from the subsoil to surface soil, and nitrogen through biological nitrogen fixation which can be further utilized by intercrops.

Fig: 2. Coconut garden without green manure in interspace

Resource conservation and weed suppression potential

Mechanical measures are not affordable by the farmers to reduce weed growth and control runoff and soil erosion because of the high cost involved. However, a vegetative measure like cover cropping is cost effective and easily adoptable by farmers. Due to its dense vegetative nature, cowpea is an excellent cover crop for weed suppression and reduction in soil loss. The dense canopy formed by cowpea covers the soil and it reduces the beating effect of raindrops thereby reducing the destruction of soil aggregate and erosion (Fig. 1). In addition, over a period of time, cover cropping of cowpea will increase soil organic matter, leading to improvements in soil physical properties viz., structure, stability and increased soil moisture and nutrient holding capacity of soil and soil fertility. Further, cowpea grown in interspaces of coconut gardens suppresses the weed growth by complete spread as compared to the coconut garden without cowpea. This allows them to save labor expenditure for hoeing and to reduce the use of herbicides thereby lowering production costs. Clark (2007) reported that, allelopathic compounds in the plant may also help to suppress weeds.

Economics

The cost of production for 1 kg of cowpea biomass works out to be about Rs.0.78 and Rs. 0.98 in red sandy loam soil and coastal sandy soil, respectively. Incorporation of 7.7 ton of cowpea biomass provides 34 kg N, 7 kg P_2O_5 and 33 kg K_2O in coastal sandy soil, while in red sandy loam soil incorporation of 11.0 ton of cowpea biomass provides 45 kg N, 10 kg P_2O_5 and 47 kg K_2O besides considerable quantity of other secondary and micronutrients. Cowpea also improves mobilization of native soil nutrients in soil because of production of various acids during decomposition of the plant materials. Thus cowpea would bring additional benefits, besides reducing the amount of fertilization needed for main as well as succeeding crop. Hence it is a more cost effective and environmental friendly method that will help to save the environment, improve soil fertility and improve crop productivity.

Conclusion:

The technology of cowpea green manuring in the interspaces of coconut helps in weed suppression and avoids runoff and soil erosion, due to its quick dense growth which covers the soil in the interspaces and avoids direct impact of rainfall on the ground. By incorporation of cowpea biomass, considerable quantity of NPK is added to the soil thereby resulted in soil fertility improvement. It also helps in biological N-fixation atmospheric nitrogen and bringing back potash and phosphorus from the subsoil within the reach of other intercrops in the coconut garden.

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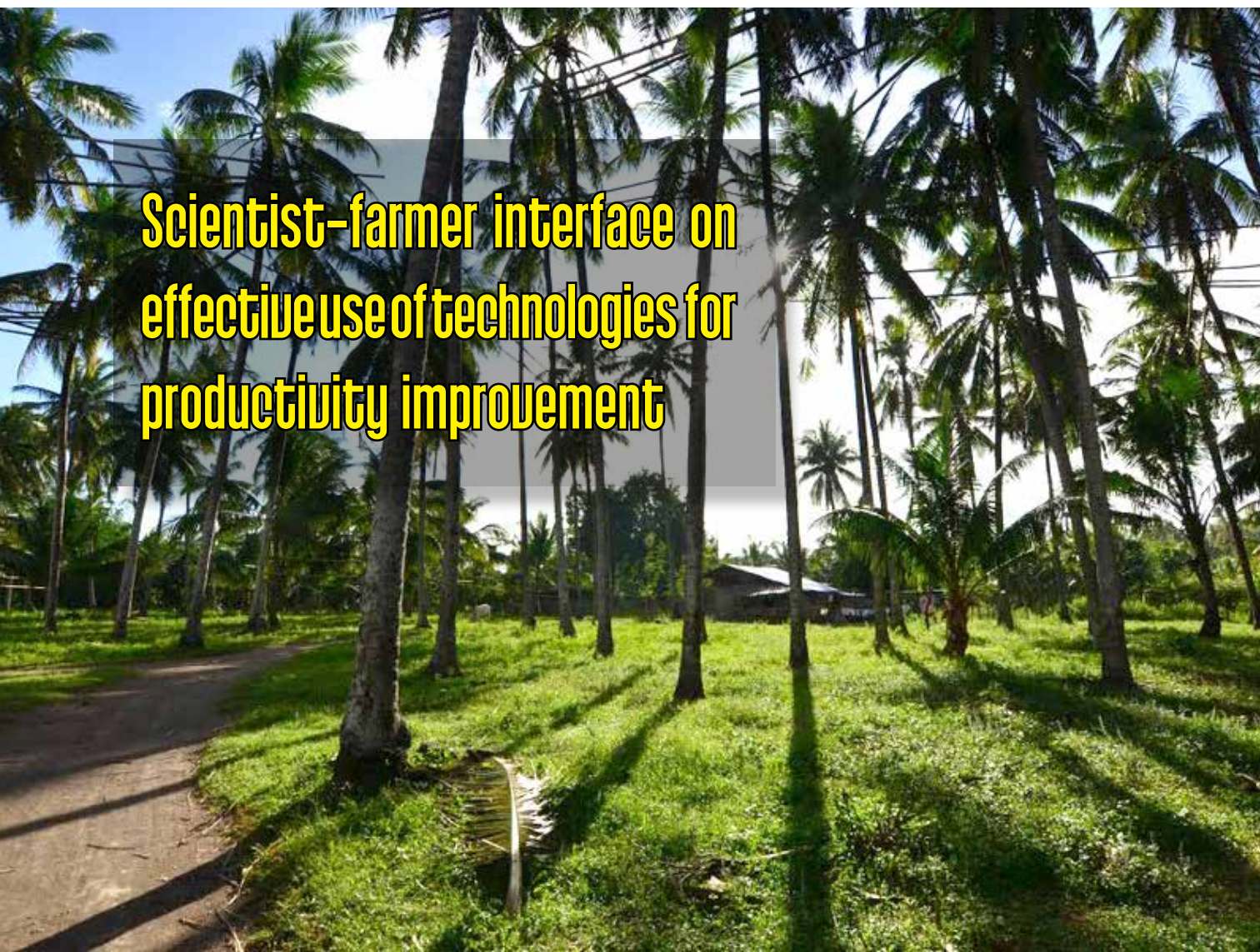
2. Maheshwarappa, H. P., Anitha Kumari, P., Kamalakshi Amma, P.G. and Shanavas, M. 2003. Cowpea (Vigna unguiculata) as a low cost input green manure crop for basin management under coconut root (wilt) garden. Indian Coconut Journal. September 2003, p. 11-13. ■

Table 1: Biomass and NPK content of cowpea grown in inter spaces of coconut.

Soil type	Fresh wt. (kg/ha)	Dry wt. (kg/ha)	Above ground parts			Below ground parts		
			N%	P%	K%	N%	P%	K%
Coastal sandy soil	7700 ± 309	1295± 76	3.02 ±0.1	0.27 ±0.26	2.47 ±0.29	1.75 ±0.06	0.2 ±0.03	1.33 ±0.19
Red sandy loam soil	11000 ± 388	1785± 78	2.93 ±0.32	0.27 ±0.05	2.46 ±0.26	1.76 ±0.16	0.2 ±0.02	1.67 ±0.19

Scientist-farmer interface on effective use of technologies for productivity improvement

Thamban, C., Jaganathan, D. and Muralidharan, K.,
ICAR- Central Plantation Crops Research Institute, Kasaragod



Coconut, the versatile tree crop, significantly influences rural economy of our country by supporting the livelihoods of millions of people. Focused research over the last one hundred years has resulted in substantial number of technologies for enhancing yield and income from coconut farming. However, coconut growers experience myriad of problems to effectively utilise these technologies to make farming remunerative. Low efficacy of transfer of technology and feedback system due to the lack of effective mechanism to ensure proper functional linkages among various stakeholders in coconut sector including researchers, extension personnel and farmers is one of the factors limiting effective use of technologies in coconut farming. ICAR-Central Plantation Crops Research Institute (CPCRI), the premier coconut research organisation, has been implementing various front line extension activities for the dissemination of research results to farmers and other stakeholders and the thrust of such initiatives is on farmer participatory technology transfer approaches.

Interactive videoconferencing to facilitate Scientist-Farmer Interface programmes

Facilitating scientist-farmer interface programmes to interact on available technologies and experiences of coconut farmers in the farm level adoption of technologies is an important technology transfer activity of CPCRI. Interactive videoconferencing has been used by the institute for organising Research-Extension -Farmer interface programmes on coconut

farming since the year 2007. This facility provides more opportunities for the researchers at the Institute to have interactions on field problems with farmers and other stakeholders located in distant places. The interactive videoconferencing programmes employ different modes of interaction between the participants. Scientist-Farmer interface mostly utilize question-answer mode at times supported by use of power point presentation followed by discussion.

Scientist-Farmer Interface programme through videoconferencing on 'Coconut cultivation practices and coconut value addition' was organised by ICAR-CPCRI during May 2017 at CDB, Kochi. During the interface, scientists at CPCRI Kasaragod and 69 selected coconut farmers and entrepreneurs representing different Coconut Producer Societies/ Federations/Companies from Ernakulam,

Improved varieties of coconut released by CPCRI	
Variety	**Area for which recommended**
Tall varieties	
Chandra Kalpa	Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra
Kera Chandra	Kerala, Karnataka, Konkan region, Andhra Pradesh, West Bengal
Kalpatharu	Kerala, Karnataka, Tamil Nadu
Kalpa Pratibha	West Coast region, Peninsular India
Kalpa Dhenu	West Coast region, Tamil Nadu & Andaman &Nicobar Islands
Kalpa Mitra	West Coast region & West Bengal
Kalpa Haritha	Kerala, Karnataka
Dwarf varieties	
Chowghat Orange Dwarf	All coconut growing areas
Kalpasree	Root (wilt) disease prevalent tracts
Kalparaksha	Kerala & Root (wilt) disease prevalent tracts
Kalpa surya	Kerala, Karnataka, Tamilnadu
Kalpa Jyothi	Kerala, Karnataka, Assam
Hybrid varieties	
Chandra Sankara (COD x WCT)	Kerala, Karnataka, Tamil Nadu
Kera Sankara (WCT x COD)	Kerala, Karnataka, Maharashtra, Andhra Pradesh
Chandra Laksha (LCT x COD)	Kerala, Karnataka
Kalpa Samrudhi (MYD x WCT)	Kerala, Assam
Kalpa Sankara (CGD x WCT)	Root (wilt) disease prevalent tracts
Kalpa Sreshta (MYD X TPT)	Kerala, Karnataka

Interactive video conferencing at CDB Kochi

Thrissur and nearby districts of Kerala state at Coconut Development Board office, Kochi interacted on various aspects of scientific coconut farming and value addition. Dr. P. Chowdappa, Director, CPCRI formally inaugurated the interface programme. In his brief inaugural address, Dr. P. Chowdappa highlighted the importance of ensuring coordination between the Coconut Producer Companies functioning in different parts of the country so that the production and marketing of value added coconut products can be streamlined in a mutually benefitting and efficient manner. He also emphasized the need for utilizing the organisationsal platforms of Coconut Producer Societies/Federations/Companies for facilitating technology transfer initiatives on scientific coconut farming and value addition with the support of coconut research and development organizations and extension agencies.

Dr. K. Samsudeen, Principal Scientist, Dr. P. S. Prathibha, Scientist, Dr. V. Selvamani, Scientist, Dr. P. P. Shameena Beegum, Scientist, Dr. D. Jaganathan, Scientist and Dr. C. Thamban, Head Social Sciences Division participated in the interface programme at CPCRI, Kasaragod. Dr. K. Muralidharan, Principal Scientist coordinated the programme at CDB, Kochi.

Thematic areas of interface programme

The broad thematic areas related to coconut cultivation and value addition on which farmers sought information from scientists during the interface programme included the following:

i) Which are the improved coconut varieties, especially dwarf varieties, recommended for cultivation? Often coconut farmers experience difficulties in obtaining required number of seedlings of improved coconut varieties. What can be done to improve the situation on planting material availability in coconut?

A large number of improved varieties of coconut have been released for cultivation which include tall, dwarf and hybrid varieties which have high yield potential and other desirable traits.

Hybrids will perform better in well managed conditions, especially with balanced fertilizer application and irrigation. Dwarf varieties of coconut are suitable for mostly tender coconut purpose. They are also used for production of hybrid coconut seedlings. Compared to dwarf varieties, tall and hybrid varieties are suitable for extraction of neera (coconut inflorescence sap). Dwarf varieties are not suitable for copra production.

The farmers participatied in the interface opined lack of availability of quality seedlings as a major constraint to adoption of improved coconut varieties. For a sustainable growth of coconut sector it is recommended to have tall, dwarf and hybrid varieties cultivated in the ratio of 60:20:20. However, the field level scenario indicates a different story; tall cultivars constitute more than 90 per cent of coconut palm population. Predominance of senile and unproductive genetically inferior local tall palm population is a major constraint in improving productivity of coconut in major coconut growing tracts like Kerala. In Kerala on an average 28-30 lakh coconut seedlings are required annually. But on an average the State Department of Agriculture, the major agency involved in coconut seedling distribution in the state, can supply only about 6-7 lakh seedlings which include mostly the West Coast Tall variety (WCT) and limited number of dwarf and hybrid seedlings, revealing a huge gap between demand and supply. Unscrupulous elements have been hugely benefitted by the situation who supplies inferior/spurious planting materials to farmers thus adversely affecting sustainable growth of coconut sector. Since most of the existing seed gardens in Kerala have been established more than 25 years back, the existing mother palms (especially dwarfs) in such seed gardens are nearing senility. Hence, urgent action should be initiated for replanting such seed gardens with parental lines of new and improved varieties recommended for the respective regions. Further, to increase the capacity for hybrid seedling production, a decentralized production mechanism is to be envisaged by maintaining a centralized pollen storage and supply mechanism.

Utilisation of superior genetic resources of coconut available in farmers' gardens is the most important short term strategy to meet the demand for coconut seedlings. Farmer participatory seedling production initiatives are to be promoted to meet the planting material requirement utilizing the locally available

> Utilisation of superior genetic resources of coconut available in farmers' gardens is the most important short term strategy to meet the demand for coconut seedlings.

resources/mother palms. However, it has to be ensured that utmost care is taken to locate and identify the superior mother palms of locally adapted coconut varieties in farmer's garden. Coconut Producers' Societies (CPS), the grass root level collective of coconut growers facilitated by Coconut Development Board, and trained youths under the Friends of Coconut Trees (FoCT) programme can play a significant role in the decentralised production and distribution of quality hybrid coconut seedlings. The process can be technically supported by research organisations such as CPCRI.

Decentralized approach for enhancing production of seedlings of improved varieties should be promoted by establishing more number of nucleus seed gardens. Such seed gardens may be encouraged in marginal and small farmer holdings. Public sector agencies including Coconut Development Board and State Department of Agriculture are having programmes for procuring seednuts from farmers' gardens. Recently in Kerala, State Department of Agriculture has implemented 'Kerasamrudhi' scheme which envisaged identifying mother palms of dwarf coconut varieties in farmers' garden and collecting seednuts. To ensure quality of planting material the criteria fixed for identification of mother palms have to be scrupulously followed in decentralized initiatives and pressure to achieve the physical target should in no way dilute the scientific procedures to be followed in selecting mother palms. To augment seedling production in the root (wilt) disease prevalent tract, selection and identification of disease-free mother palms in 'disease hotspots' should be given more emphasis rather than large scale procurement of seed nuts from other areas.

ii) Low price of coconut/market fluctuation is a major problem experienced by coconut farmers. How coconut based multiple cropping/integrated farming can be popularized as a strategy to make coconut farming economically viable under such a situation?

Systematic coconut based cropping/farming system is an important strategy to make coconut farming economically viable in small holdings. This strategy is highly relevant in the present day context since currently coconut farmers are more exposed to economic risks and uncertainties owing to the high degree of price fluctuations. In spite of the obvious benefits of coconut based farming system over the traditional monoculture, the extent of adoption of the recommended cropping/farming systems is not at a satisfactory level. However, there are cases of farmers who are highly successful in field implementation of multiple cropping/integrated farming in coconut. Similarly, some grama panchayats also have successfully implemented interventions related to coconut based farming system under the peoples' campaign for decentralized planning programme. The potential for strengthening food and nutritional security through the adoption of appropriate coconut based intercropping/mixed farming also need to be effectively utilized.

Inter/ mixed crops are to be selected based on the age of the palms, size of the crown and availability of sunlight in the garden. A variety of inter crops like pineapple, banana, elephant foot yam, groundnut, chillies, sweet potato and tapioca can be raised in coconut gardens upto 8 -10 years. During the second growth phase of palms, i.e., 10 to 22 years of age, growing of other crops in the interspace may be difficult due to poor sunlight availability. However, crops like colocasia, some varieties of banana like palayamkodan etc. which can tolerate shade can be cultivated in this phase. After the palms attain a height of 5 to 6 metres (above 22 years) i.e., in older plantations, perennials like cocoa, pepper, cinnamon, clove and nutmeg can be grown as mixed crops along with the intercrops. In places where rainfall is not well distributed, irrigation is necessary during summer months. However, these crops are to be adequately and separately manured in addition to the manures applied to coconut palms. Mixed farming by raising fodder grasses such as hybrid Napier or guinea grass along with leguminous fodder crops such as Stylosanthes gracilis in coconut gardens has been found to be profitable. Raising the above crops in one hectare of coconut garden can support four to five dairy animals. In addition to the cattle, poultry, pisiculture and apiculture may be integrated depending upon the farmers interest. The cattle and poultry manure generated from the system when applied to coconut garden improves the soil fertility considerably. Maintaining milch cows and other components in coconut garden helps the

farmer to enhance his income and provide additional employment to the family.

The experiences of CPCRI in facilitating Community Based Organisations of small and marginal coconut growers under different research projects including the IPGRI-COGENT project on 'Developing sustainable coconut based income generating technologies in poor rural communities' and National Agricultural Innovation Project (NAIP) sub-project on 'Value chain in coconut' has clearly demonstrated that adoption of coconut based cropping/farming systems is an effective strategy for enhancing productivity and income. Appropriate schemes are to be implemented by agencies like Coconut Development Board, State Department of Agriculture and Local Self Governments for popularising coconut based cropping/farming systems. Coconut Producers' Societies/Federations can facilitate implementation of such schemes at the grass root level.

iii) Productivity of many coconut gardens is on the decline. What are the major reasons for the low productivity and how productivity can be enhanced?

Various reasons can be attributed to the low productivity of coconut. One of the major reasons is low level of adoption of crop management practices including nutrient management, irrigation and water management. Hence, it is important to implement programmes based on a strategy for promoting interventions to ensure adequate care and management of coconut palms in the existing gardens to enhance productivity.

The study funded by Kerala State Planning Board on fertility of soils of Kerala has revealed that soil related constraints viz., very strong soil acidity, extensive deficiency of secondary nutrients calcium and magnesium and wide spread deficiency of micro-nutrient boron are among the important factors for low productivity of coconut in the state. In this background a project supported by State Planning Board for demonstrating the efficacy of Best Management Practices including site specific nutrient management based on soil and plant analysis data for enhancing productivity of coconut is being implemented in 60 selected coconut gardens in six agro-ecological units located in six districts in Kerala state @10 gardens per location since the last two years. An innovative extension service delivery model has been initiated in the project area with special emphasis on promoting soil health management practices evolved to address the soil related constraints for enhancing productivity and income from coconut farming in different agro-ecological units. The model assimilates the socio-economic realities while addressing the lacunae in the existing models of extension strategies. The rising share of non-farm income sources, shifts in demographic pattern affecting availability of family labour and hired labour, inefficiencies in input delivery system, predominance of small holder producers, etc. were found to influence the production effort and consequently, technology adoption. The extension approach adopted involved restructuring of crop management practices and concurrent monitoring to address the low level of management inputs and the constraints arising out of changes in agrarian structure. The initial results of interventions under the project indicate the scope for enhancing the economic viability of coconut based land use systems through the innovative approach. It is also worthwhile to explore the potential for scaling up of interventions through Agricultural Technology Management Agency (ATMA), State Department of Agriculture and Local Self Government initiatives. Simple technology for vermicomposting of coconut leaves as part of on farm organic matter recycling in coconut gardens is very relevant in the context of growing awareness about organic farming/eco-friendly farming in Kerala.

Rainfed cultivation of coconut is another important reason for low productivity in Kerala. Water scarcity experienced by the palms during summer from December to May months adversely affects coconut production. The problem is more severe in northern Kerala where rainfall distribution is highly skewed. In water scarce areas drip irrigation is to be promoted to irrigate coconut palms to achieve higher water use efficiency. If there is drip irrigation facility, then the water soluble fertilizers can be applied to coconut palms along with drip irrigation (fertigation) for higher fertilizer use efficiency. Adoption of soil and water conservation measures in coconut gardens

enhances coconut productivity. Analysis of impact of technological interventions under Farmers Participatory Action Research Programme (FPARP) implemented by CPCRI in coconut gardens in farmers' field revealed the efficacy of soil and water conservation technologies for water saving/water use efficiency, yield enhancement in crops and enhancing cropping intensity. The activities under FPARP also led to enhancement in knowledge about soil and water conservation measures and level of participation of farmers in implementing soil and water conservation interventions. The interventions also revealed the potential for scaling up these technologies in farm holdings in the west coast region having coconut based cropping systems with agroclimatic situation similar to the project area. Coconut Producers' Societies/Federations can facilitate formulation and implementation of watershed based development schemes at the grass root level with the support of relevant development agencies so that coconut gardens covered under the watershed area get benefitted by way of implementing soil and water conservation measures for enhancing coconut productivity.

iv) Product diversification is suggested as an important strategy to enhance income from coconut farming and virgin coconut oil is getting popular as a value added product. What are the technologies for virgin coconut oil production? Is there any quality standard fixed for VCO? Similarly opportunity for the production and marketing of neera has raised lot of expectation among coconut growers. However, coconut producer federations involved in the neera production are facing lot of technological/marketing problems. How to overcome these problems?

To cope with the market fluctuations, there is a need for product diversification and byproduct utilization. Hence, promotion of farm level and community level processing of diversified products and byproducts obtained from coconut palm are highly imperative. Technological research has been successful in evolving appropriate processing technologies for the profitable utilization of products and by-products of the coconut palm including tendernut, coconut kernel, coconut water, coconut wood, shell and leaves. Tender coconut marketing is one of the profitable activities which need to be promoted in the state. Farmer's collectives as well as enterprising youths are to be supported in organizing marketing outlets in potential areas for tender coconut.

Of late, virgin coconut oil is getting popular as a value added product in the domestic and export markets. Virgin coconut oil is the oil obtained from fresh, mature endosperm (kernel-meat) of the coconut by mechanical or natural means, with or without use of heat, no chemical refining, bleaching or de odorizing and maintains the natural aroma and nutrients. It is called "virgin" because the oil obtained is pure, raw and pristine. Virgin coconut oil is suitable for human consumption in its natural form. It is the purest form of coconut oil, crystal clear, contains natural vitamin E and with very low, free fatty acid content (0.1 %). It has a fresh coconut aroma ranging from mild to intense depending on extraction process.

The different processes involved in VCO production are Hot-processing method, Natural fermentation method, Centrifugation process and extraction from dried grating (EDG) method. The choice of the technology to be adopted depends to a great extent on the scale of operation, the degree of mechanization, the amount of investment available and the market demand. The modified hot process method for producing VCO also follows the same principle except for controlled heating to prevent the oil from turning yellow and maintain the moisture content less than 0.2 % to prolong its shelf life. Hot process comprises of two stages: extraction/ preparation of coconut milk and cooking the milk to get VCO. In fermentation method, the VCO can be produced in a home-scale operation using ordinary kitchen utensils after extracting the coconut milk. The oil produced in this method is water-clear in colour. The VCO produced could turn sour if the fermentation period is prolonged and the fermentation process conditions are not controlled properly. Fermentation method comprises of two stages: extraction/ preparation of coconut milk and fermentation of the milk for VCO production. In centrifugation method, the coconut milk is subjected to mechanical phase separation process. Coconut milk and hot water is fed in a three-way centrifuge equipment where the oil

separates out from the top and the water and sludge comes out through separate outlets. It produces the best quality oil with sweet coconut aroma and the oil produced in this method is water clear in colour.

Quality standards for VCO as fixed by Asian Pacific Coconut Community (APCC) are as follows:	
Chemical parameters	APCC quality standards for VCO
Colour (Lovibond)	Water clean
Refractive index at 40^{o}C	1.4480-1.4492
Saponification value	250-260
Iodine value	4.1-11.0
Specific gravity at 30^{o}C	0.915-0.920
Moisture (%)	0.1-0.5

Another strategic area which has raised lot of expectation is the potential for production and marketing of neera. Various value added products like coconut palm sugar, palm jaggery, coconut honey and coconut syrup can also be made from neera. Technologies are now available for preserving and packing coconut inflorescence sap as 'neera 'or sweet toddy as non-alcoholic health drink. The Government of Kerala has amended the abkari act and coconut producer federations are issued license to produce, process and market neera. Many such federations have started producing and marketing neera. Issues concerned with neera production at policy level include ceiling for the number of coconut palms to be tapped/ day, the selling controls on the product, the registration formalities etc. In the production front, scarcity of skilled tappers and lack of adequate infrastructure for processing are the major problems. Marketing of neera also poses challenges as consumer perception and buyer segment studies are completely lacking and profit analysis are based only on projections without any structured marketing studies. Further to compete with other similar product, it has to be appropriately positioned for its nutritional edge. As demanded by the Coconut Producer Federations efforts are required for the assessment and refinement of neera production technologies. Since it is an evolving product, lack of product uniformity may hamper the market penetration. However, the unexplored markets and preparedness to meet the demand are the opportunities.

Encouraging more entrepreneurs in coconut sector by establishing 'Coconut Parks' by state government for organized processing for value addition will help coconut farmers to de-link the over dependence on coconut oil in determining coconut price.

ICAR-CPCRI supports entrepreneurs who are interested in coconut based agribusiness ventures. Hands on training on potential technologies with nominal technology transfer fee and MoA between CPCRI and entrepreneurs is done through agribusiness incubation centre of CPCRI.

V. Farmers' experience huge crop loss in coconut due to insect pests like, rhinoceros beetle and red palm weevil. Recently, spiralling white fly has also been observed in various localities of coconut growing areas. What are the scientific crop protection measures against these pests?

Integrated pest management practices have been standardized by ICAR- CPCRI. Judicious use of various management practices namely, cultural,

Rhinoceros beetle	
Symptoms	**Management**
• Adult beetles bore into the spindle leaf causing diamond shaped cuts (V-shaped) upon unfurling as well as exposing chewed up fibres from feeding site. • Beetles feed on the unopened inflorescence leading to necrosis and drying of spathe. • Beetles bore into the collar region of the young seedlings.	• Hooking out the beetle • Filling up top most leaf axils with 250 g neem cake along with equal volume of sand. • Placement of two naphthalene balls on top-most two leaf axils Placement of two perforated sachets containing chlorantraniliprole (0. 4% ai) (3 g) or fipronil (80% ai) (3 g) • Incorporation of weed, Clerodendron infortunatum on the manure pits to induce larval-pupal abnormalities in feeding grubs. • Application of green muscardine fungus, Metarhizium anisopliae on the breeding pits @ 5 x 1011 spores / m3. • Release of 10-12 virosed (Oryctes rhinoceros nudivirus) beetles for pest reduction. • Use of PVC pheromone traps 'Oryctalure [ethyl 4 methy octonoate]' and field delivery using nanomatrix @1 trap / ha

Rugose Spiralling Whitefly	
Symptoms	**Management**
• Sucking of coconut sap by selective feeding on the under surfaces of the leaflets. • Extensive feeding leads to the excretion of honey dew which subsequently gets deposited on the upper surface of the leaves which later turn black colour.	• Application of 1% starch solution on leaflets to flake out the sooty moulds. • Installation of yellow sticky traps on the palm trunk as well as in interspaces to trap adult whiteflies. ● Encourage build up of parasitoids (Encarsia sp.) and re-introduce parasitized pupae to emerging zones of whitefly outbreak. ● In severe case, spray neem oil 0.5% and no insecticide is recommended.

Red palm weevil	
Symptoms	**Management**
• Choking of spindle leaves with improper emergence and sometimes wilting. • Yellowing of middle whorls (1-2 fronds) at the site of attack • Leaf splitting, presence of feeding bore holes in fronds, trunk with exudation of viscous brown fluid. Toppling down of crown in advanced stage of infestation.	• Systematic diagnosis and vigilant scouting for early diagnosis. • Avoiding physical injury to palms • Cutting fronds leaving at least 1 m from trunk, evading knife injury on crown region • Prophylactic leaf axil filling with oil cakes (250 g) admixed with equal volume of river sand/ naphthalene balls (12 g)/ polythene-sachet containing 3 g chlorantraniliprole (0.4 %) or 3 g fipronil • Application of 0.02% imidacloprid 17.8 SL (@1.12 ml per litre of water) • Growing of intercrops such as fruit trees and spices.

biological, mechanical and chemical methods are emphasized for managing these pests as described below.

Area wide community extension approach for managing coconut insect pests: ICAR - CPCRI took the initiative to evolve area wide community extension approach (AWCA) for management of coconut pests which was scaled up in several districts subsequently. The model community extension approach underscores the role of linkages with peoples' representatives, farmer organizations, farmer leaders, co-operative societies of farmers and co-ordination with various extension departments and research institutions.

The critical component of the extension approach is the decentralized option for technology facilitation viz. capacity building of farmer groups as master trainers and farm level producers of different critical inputs and targeting the 'potential and critical adopters' against major insect pests of coconut. Through this approach, more than 90 per cent of the potential adopters can be reached within short period and pest infestation can be reduced considerably.

Conclusion

Coconut is an important plantation crop which supports millions of farmers in India. Farmers are facing lot of field problems which are to be addressed by research and developmental agencies. Based on the experiences gained during the interactive video conferencing programme, it is felt that research-farmer-extension interface is the need of the hour to understand the field problems and also to create awareness on modern scientific technologies among farmers. Hence, this type of efforts should be continued for strengthening transfer of technology programmes for improving productivity and profitability from coconut farming. ■

Market review – June 2017

Domestic price

Coconut Oil

During June 2017 the price of coconut oil opened at Rs. 13500 per quintal at Kochi, Rs.13600 per quintal at Alappuzha market and Rs.14600 per quintal at Kozhikode market expressed a declining trend at all three markets during the month.

The price of coconut oil closed at Rs.13100 per quintal at Kochi market and Alappuzha market and Rs.14300 per quintal at Kozhikode market with a net loss of Rs.400, Rs.500 and Rs. 300 per quintal respectively.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.11533 per quintal, expressed an erratic trend and closed at Rs.10867 per quintal with a net loss of Rs.666 per quintal.

Table1: Weekly price of coconut oil at major markets Rs/Quintal)

	Kochi	Alappuzha	Kozhikode	Kangayam
01/06/2017	13500	13600	14600	11533
04/06/2017	13400	13500	14600	11333
11/06/2017	13400	13400	14500	11333
18/06/2017	13300	13300	14500	11000
25/06/2017	13100	13100	14300	10867
30/06/2017	13100	13100	14300	NT

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.8900 per quintal at Kochi, Rs.9000 per quintal at Alappuzha market and Rs.9400 per quintal at Kozhikode market. The price of milling copra expressed a declining trend at all three markets during the month.

The prices closed at Rs.8500 at Kochi, Rs.8700 per quintal at Alappuzha market and Rs.9050 at Kozhikode markets with a net loss of Rs.400, Rs.300 and Rs.350 per quintal respectively.

At Kangayam market in Tamilnadu, the prices expressed a slightly fluctuating trend. The prices opened at Rs.8200 and closed at Rs. 8100 per quintal with a net loss of Rs.100 per quintal.

Table2: Weekly price of Milling Copra at major markets (Rs/Quintal)

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01/06/2017	8900	9000	9400	8200
04/06/2017	8800	8950	9350	8100
11/06/2017	8800	8900	9200	8050
18/06/2017	8700	8850	9200	8100
25/06/2017	8500	8700	9050	8000
30/06/2017	8500	8700	9050	8100

Edible copra

The price of Rajapur copra at Kozhikode market which opened at Rs.9000 per quintal expressed a mixed trend during the month. The prices closed at Rs.8800 per quintal with a net loss of Rs.200 per quintal.

Table3 :Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01/06/2017	9000
04/06/2017	8900
11/06/2017	8600
18/06/2017	9000
25/06/2017	8700
30/06/2017	8800

Ball copra

The price of ball copra at Tiptur market which opened at Rs.7800 per quintal expressed a mixed trend during the month and closed at Rs.7800.

Table 4 : Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
	Tiptur
01/06/2017	7800
04/06/2017	7800
11/06/2017	7750
18/06/2017	7900
25/06/2017	7700
30/06/2017	7800

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.7300 per quintal. The price expressed a declining trend during the month and closed at Rs.6600 with a net loss of Rs.700 per quintal.

Table5 : Weekly price of Dry Coconut at Kozhikode market (Rs/1000 coconuts)	
01/06/2017	7300
04/06/2017	7300
11/06/2017	7000
18/06/2017	6600
25/06/2017	6600
30/06/2017	6600

Coconut

At Nedumangad market the price of partially dehusked opened at Rs. 14250 and ruled at same price throughout the month. At Bangalore APMC, price of partially dehusked coconut opened at Rs.18500 per thousand nuts and closed at Rs.19000 per thousand nuts with a net gain of Rs.500. At Manglore APMC market the price of partially dehusked coconut of grade-I quality opened at Rs.20000 per thousand nuts and ruled at same price throughout the month.

Table 6: Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Banglore	Mangalore (Grade-1)
01/06/2017	14250	18500	20000
04/06/2017	14250	18500	20000
11/06/2017	14250	NA	NA
18/06/2017	14250	19000	20000
25/06/2017	14250	18000	20000
30/06/2017	14250	19000	20000

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)	
01/06/2017	10000
04/06/2017	10000
11/06/2017	10000
18/06/2017	10000
25/06/2017	10000
30/06/2017	10000

International price

Coconut oil

The domestic price of coconut oil at Philippines, Indonesia and India expressed an erratic trend during the month. 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 May 2017

	International Price(US$/MT)	Domestic Price(US$/MT)		
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	India*
01/06/2017	n.q.	1746	1884	2082
04/06/2017	1814	1780	1571	2086
11/06/2017	n.q.	1849	1612	2063
18/06/2017	n.q.	1686	1672	2031

* Kochi Market

Copra

The domestic price of copra at Indonesia and Srilanka expressed a declining trend during the month whereas the price of copra in Philippines and India expressed a slight fluctuating trend.

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

	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India*
01/06/2017	1042	1015	1502	1368
04/06/2017	1051	1015	1448	1370
11/06/2017	1047	1013	1448	1350
18/06/2017	1050	1011	1375	1318

* Kochi Market

Desiccated coconut

The FOB price of desiccated coconut in India during the month of May was competitive compared to the international prices of major DC exporting countries.

Table 10: Weekly price of desiccated coconut during May 2017

	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
01/06/2017	2640	2400	2962	2151
04/06/2017	2640	2410	3018	2371
11/06/2017	2668	2410	2782	2262
18/06/2017	2673	2400	2964	2260

*FOB

Coconut

The price of dehusked coconut in all major coconut producing countries expressed an overall declining trend during the month. The price of coconut quoted at different domestic markets is given below.

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

Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
01/06/2017	224	263	275	404
04/06/2017	226	263	266	397
11/06/2017	225	263	263	396
18/06/2017	219	255	239	388

*Pollachi market

Coconut shell charcoal

The domestic price of coconut shell charcoal was competitive compared to the prices quoted in Indonesia and Srilankan markets.

Table 12: Weekly price of coconut shell charcoal during May 2017

Date	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India
01/06/2017	386	473	453	404
04/06/2017	406	474	432	405
11/06/2017	406	474	514	403
18/06/2017	406	449	456	403

*Kangayam

Monthly Operations- August

Andaman & Nicobar Islands: Search for bud rot and rhinoceros beetle attack and adopt suitable control measures. If coconut husk is available, dig trenches of 50 cm wide and 50-60 cm deep between rows of palms and bury husk in them with concave surface up and cover with soil. Clean the basins of coconut seedlings planted in the main field.

Andhra Pradesh : Plough in situ the green manure crops raised. Search for rhinoceros beetles on the crowns of the palms and hook out the beetles by beetle hook and destroy them. As a prophylactic measure against the infestation of rhinoceros beetle, fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/ palm) and cover them with sand thrice a year. Spray the palms with one per cent bordeaux mixture as a prophylactic measure against fungal disease. If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre water on the bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Assam : If stem bleeding disease is noticed (1) remove the affected bark tissues on the stem and apply 5 percent calixin on the wound and apply warm coal tar (2) root feed the affected palm with 5 percent calixin @ 100 ml solution per root at quarterly intervals (3) apply 5 kg neem cake per palm per year along with the second dose of fertilizers (4) regulate optimum field moisture by providing drainage during rain and irrigate the palms during summer. Prevent accumulation of water in the pits of transplanted seedlings. Clean the drainage channels to avoid chances of water logging.

Bihar / Madhya Pradesh : Open circular basins of 2m radius and 15-20 cm depth around the palms, if not taken during the month of July. Apply 30-50 kg farmyard manure/compost per palm in the basins already taken. If green manure crop is raised, plough it in situ or apply this to the basins around the palms. Transplanting of selected good quality seedlings can be done during this month. Plant the seedlings in such a way that the collar region is not covered with soil. Do not allow water to accumulate in the newly planted pits. Check the crown for bud rot or pest infestation and adopt measures to control them. Clean the crowns of the palms by removing all the dried and decayed matter which will come off easily when pulled by hand. Tie or prop up bunches to prevent buckling. If fertilizer application is not yet done, do it and cover the basins completely.

Karnataka : If green manure crop is raised cut them before flowering and apply it to the basins around the palms. Clean the crowns of the palms and tie or prop up bunches to prevent buckling.

Search the crowns of trees for bud rot attack. If bud rot attack is observed remove all the affected tissues and apply bordeaux paste over cut ends and cover with polythene to avoid entry of water. Check for rhinoceros beetle and red palm weevil and adopt appropriate measures. Against red palm weevil, inject one per cent carbaryl. Continue planting of seedlings in new plantations. If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre of water on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Kerala/Lakshadweep: If leguminous green manure crops are grown plough in situ them. Clean the crown of palms and tie or prop up young bunches to prevent buckling. Soil application of phorate 10G @100g/ palm or drenching the root zone with chlorpyriphos 20EC @ 2.5ml per liter of water during May- June and September – October controls the pest. If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre of water on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Maharashtra/Goa/Gujarat: The green manure crops, weeds, etc. may be ploughed back into the soil. Tie up heavy bunches with a rope to prevent buckling. If attack of rhinoceros beetle is noticed, as a prophylactic measure fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year.

Orissa : Dig up grass and weeds and turn them into the soil. Clean the crowns of the palms. Tie up tender bunches. Prepare land for sowing winter vegetables.

Tamil Nadu/Pondicherry: If green manure crop is raised plough it in situ or apply to the basins around the palms. Clean the crowns of the palms and tie or prop up bunches to prevent buckling. In irrigated gardens apply ¼th of the recommended dose of fertilizers (third dose). If the attack of the mite is noticed, spray neem oil - garlic - soap emulsion 2 percent (20 ml neem oil + 20 gm garlic emulsion + 5 gm soap in 1 litre water) or commercial botanical pesticides containing azadirachtin 0.004 per cent @ 4ml per litre of water on bunches, especially on the perianth region of buttons and affected nuts or root feed neem formulations containing azadirachtin 5 per cent @ 7.5 ml with equal quantity of water.

Tripura : Clean the crowns to protect the palms from any pest/ disease attack. The entire crown should then be sprayed with one per cent bordeaux mixture. If attack of rhinoceros beetle is noticed, as a prophylactic measure fill the youngest three leaf axils with a mixture of 250g powdered marotti/ neem cake with equal volume of sand or place naphthalene balls(12g/palm) and cover them with sand thrice a year. Second dose of fertilizer should be applied during the month. After application of fertilizer if there is no rain, irrigation should be done.

West Bengal : Harvest matured nuts. Clean the crowns and remove dried leaves. Search for rhinoceros beetle and red palm weevil and take control measures. Spray one per cent bordeaux mixture or copper oxychloride preparations (0.5 per cent) on the crowns of palms against the incidence of bud rot, leaf rot and immature nut fall due to Mahali. ■