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## Message from the Chairperson's desk

Dear Readers,

As you are aware, India is the top producer of coconut in the world and the coconut production in the country is to the tune of 21308 million nuts as per the second estimate for 2019-20 released by the Ministry, an incremental increase over the previous year. This increase has happened in spite of the impact of the major cyclones like Gaja, Titli etc which caused damage to the plantations in the east coast. The export of coconut products from the country (except coir and coir products) during 2019-20 is Rs. 1762.17 crores with activated carbon being the major coconut product exported.



Though the prices have fallen below the Minimum Support Price announced by Government of India in major coconut producing areas, State Governments have already approached the Ministry to initiate copra procurement under MSP which will be a great relief to the coconut farmers. The Board is going ahead with the annual plans concentrating on ensuring availability of good and quality planting materials, area expansion, productivity improvement and facilitating the farmers to get a steady and remunerative price for their produce.

Let us strive hard to attain the objectives foreseen to the benefit of the coconut farmers and maintain the esteem position of the Indian farmer in the international coconut scenario.

G Jayalakshmi IAS  
Chairperson



# Coconut based Integrated Farming System Model - Success story

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Coconut has the status of a plantation crop worldwide. Among the main coconut producing states in the country, Kerala ranks first in area and production. Coconut is raised in 7.61 lakh ha and occupies 29.6 per cent of the gross cropped area. However, with respect to productivity it is fifth, next to Andhra Pradesh, Tamil Nadu, West Bengal and Karnataka (Coconut Development Board Statistics 2017-18). Unlike several countries, where coconut is grown in large gardens, Kerala has a unique feature of presence of coconut based home gardens, which have evolved in response to the pressure of shrinking land resource base coupled with high population density. According to the Tenth Agricultural Census of Kerala, the average size of an operational holding was 0.18 ha in 2015-16. This was against 0.22 ha in 2010-11. Also, out of the total holdings, the size group below one ha (marginal farmers) accounts for 96.7 per cent of the total number of holdings and the average size of the group is 0.12 ha (Department of Economics and Statistics, 2019). It is for the populous marginal

homestead farmers that intensive land use practices like multitier cropping and integrated farming are becoming increasingly important.

Coconut-based cropping systems are popular in many parts of the world. Multiple cropping in coconut is the most prevalent and chief form of commercial and government-promoted agroforestry. Although most smallholders have intercropped coconuts with arable crops and trees as part of the traditional agroforestry systems, many institutions continue to encourage the intercropping of only selected crops and trees with coconuts. In many cases, this effort has taken the form of the systematic planting or replanting in existing garden areas of regularly spaced palms, which can then be undercropped. Alternatively, undercropping in existing commercial groves of coconut palms has been systematically encouraged. Farmers cultivate a host of crops including perennials, annuals and seasonal crops along with coconut, without identifying optimum crop combinations.



**Table 1. Coconut based IFS model (0.2 ha ie 50 cents)**

Components	Area (m <sup>2</sup> )
Coconut (WCT) on bunds and adjoining area (30 nos.)	1480
Teak trees along the border (15 nos.)	400
Multitier cropping	
Papaya (6), Garcinia (1), Nutmeg (1), Cocoa (1), Rose apple (1), (1), spices (ginger + turmeric), Clove (1), tuber crops, fodder crops and vegetables	In interspaces of coconut
Mango (1), Bread fruit (1), Jack (1)	
Azolla (in shallow pit of size 2 x 1 x 0.2 m <sup>3</sup> , lined with silpaulin) -2 units	20
Apiculture unit (Stingless bee): 1 unit	Beneath coconut
Cow unit : cross bred (1+1)	100
Fresh water fish (GIFT: Genetically Improved Farm Tilapia reared)	In trenches dug between the bunds planted with coconut
Total	2000

Coconut based products are currently booming in popularity the world over, but the farmers of coastal tracts of India, where coconut is the major crop often find themselves in a predicament. Coconut when grown as monoculture leads farmers to distress many a times, mainly due to crop loss associated with pests and disease incidences, and market price fluctuations. However, it has been well established that resorting to coconut based integrated farming can well enhance the yield from unit area and bring about considerable spike in farm income, apart from environment friendly effects resulting from saving of fertilizers due to on farm generation of nutrients. Social relevance of such systems is significant as evidenced from the generation of more employment opportunities.

In the past years, attempts to improve the coconut based farming systems have been mainly through a piece meal approach. The crops/enterprises and its management aspects have been singled out and development projects formulated. Improvement of this complex farming system can be achieved only through a whole-farm or integrated systems approach.

The Integrated farming System Research Station (IFSRS), functioning under Kerala Agricultural University at Thiruvananthapuram, is a network centre of the All India Co-ordinated Research Project on Integrated Farming Systems of ICAR, the apex body coordinating research on integrated farming at the National level. The station has developed and validated a highly successful model for coconut based integrated farming (0.2 hectare) which especially suits the land area and other resources of small



and marginal farmers of the state. Research works carried out for five years suggest that the model is quite successful in generating higher yields, better income and is quite eco-friendly in terms of on farm generation of nutrients. The various components included in the model are detailed in Table 1.

### The model: Main (base) crop and intercrops

The establishment of the IFS model was initiated during the year 2011-12. The experimental site was a low land (5 m above mean sea level). Coconut palms (West Coast Tall) of fifteen years of age were already planted on raised bunds at the recommended spacing of 7.5 m between palms. Different intercrops like fruit trees, spices, fodder crops (hybrid napier, guinea grass, para grass), spices, beverage crops, tuber crops (cassava, coleus, sweet potato and yams) and vegetables (amaranthus, cowpea, ash gourd etc) as detailed in Table 1 were then planted in the interspaces between palms. All along the boundaries of this model, miscellaneous trees (timber yielding and fruit trees) were planted.



### Genetically Improved Farm Tilapia (GIFT): a profitable component

Fisheries, a highly profitable allied enterprise is included in the model. Water channels of 1.5 m depth naturally formed in between coconut bunds as a result of excavation of soil are utilized for fish rearing. Genetically Improved Farm Tilapia (GIFT), a promising fish species which is highly remunerative and suited to shallow water channels is reared in the channels. Fingerlings of GIFT are procured from Vallarpaadam hatchery under MPEDA (Marine Products Export Development Authority) @ Rs. 6 - 10/fingerling (depending on size). The fingerlings of size 1 cm are reared in tanks for one and a half months till they attain a size of 5 cm and thereafter released to water channels. Before release, the channels are dewatered, cleaned and predatory fishes, if any, which may possibly harm GIFT fingerlings, are removed. The pH of water needs to be maintained around 6 - 7 for GIFT culture and therefore, acidity of water is periodically corrected by adding lime. GIFT can be reared under low density (3-4 fingerlings per square metre) or under high density (5-6 fingerlings per square metre). Under low density, though number of fish harvested is less, their individual weight will be higher. Under high density though more number of fish are harvested, their weight is less. Feed is supplied @ 10 per cent of body weight of fish. For deciding the quantum of feed to be given,

the fish is randomly caught and weighed periodically. GIFT is harvested at 6-8 months of age. The weight of a fish averages between 250-350 g under high density and 600 to 750 g under low density. The fish fetches good price ie. Rs.300/kg. In this model, from the trench area of 5 cents (200 m<sup>2</sup>), about 200 kg fish could be harvested per cycle, contributing to gross returns as high as Rs.60000/-. Undoubtedly, fisheries is a remunerative enterprise of the model. Moreover, the flesh of GIFT is very tasty and is having much preference in market. Inclusion of fisheries is a very good example of effectively utilizing every bit of land leaving no fallow. Thus, one of the basic principles of integrated farming ie., the most productive utilization of available land is also effectively achieved.

### Other enterprises

Other allied enterprises include a dairy unit comprising of a cow and a calf (cross bred). Dung and urine from the dairy unit in turn support organic crop nutrition within the model. A bee hive, houses stingless honeybee which besides supplying honey of medicinal value augments effective pollination of crops managed in field. The fodder unit maintained in the model supplies fresh green fodder. As a supplementary enterprise to support the fisheries unit, two azolla units are maintained in artificially created shallow tanks. The azolla serves as fish feed thereby reducing the feeding cost.

### Nutrient generation from the model

Crop residues and dairy outputs (cow dung, cow's urine, stall wash etc) serve as major sources of nutrients within the system. Pond silt rich in plant nutrients, excavated from the fish rearing channels in alternate years also contribute nutrients. The nutrient content of these resources were estimated and plant nutrient generation quantified on an annual basis. It is evident that on an average, plant nutrients to the tune of 177 kg nitrogen, 89 kg phosphorus and 98 kg potassium were generated annually from the model (Table 2). These nutrients were recycled into the system itself, thereby reducing the cost likely to be incurred towards chemical fertilizers. The heavy

**Table 2. On farm generation of major plant nutrients from the 0.2 ha model (kg)**

Nutrients (kg)	Period under study					Average
	2014-15	2015-16	2016-17	2017-18	2018-19	
Nitrogen	173	127	199	222	166	177
Phosphorus	68	69	105	117	87	89
Potassium	71	76	113	125	103	98



Ginger intercropped in coconut interspaces

**Table 3. Yield, economics and employment generation from the IFS model**

Year	Coconut Equivalent Yield (Nuts / 0.2ha)	Gross Returns (Rs.)	Net Returns (Rs.)	B:C Ratio	Employment generation (Man days per year)
2014-15	12213	183201	52781	1.40	79.5
2015-16	10776	183191	56922	1.45	69.0
2016-17	13704	232962	52595	1.28	101.0
2017-18	14274	242663	69055	1.4	90.0
2018-19	15170	257891	60919	1.31	87.0

use of (fossil) energy in modern agriculture, mainly through the use of artificial fertilizers is reflected in very low energy output-input rates in the production of certain food products (Heilig, 1993). Hence, reducing the dependence on chemical fertilizers is of considerable significance in the context of environmental benefits. The energy saving accrued by reducing the use of chemical fertilizers in the model was to the tune of 12573 Mega Joules.

On an average, the fertilizer equivalent of the nutrients generated was 386, 446 and 163 kg of urea, rock phosphate and muriate of potash respectively. The price equivalent of the saved fertilizers was worked out as Rs.8236/- in the 0.20 ha model.

Recycling of biological resources, wastes and by-products can improve farm natural resources and incomes. It is always beneficial to integrate enterprises that are particularly good at promoting recycling. For example, the cow eats grass and crop residues and produces organic manures for crops. Fishes are another enterprise that perform ecological services and save money by converting crop, livestock

and household wastes into high quality protein and nutrient rich pond mud. Besides, pond mud is so rich that it can replace fertilizer completely in small vegetable gardens. Hence, recycling can have significant impacts on the ecological sustainability of the entire farming system.

### **Diverse production and food security through integrated farming**

The yield, economics and employment potential of the model are presented in Table 3. It is evident that a switch to integrated farming model can very well enhance production up to even tenfold. This is of very high significance as far as a marginal farmer is concerned.

Considering the fact that the average productivity of coconut from 0.2 hectare in Kerala is as low as 1378 nuts, the enhancement in productivity up to 13227 nuts by switching to integrated farming system is of very high significance. Average gross returns from the model were Rs.219982. Average net income was Rs. 58454 and the Benefit: Cost ratio was



## Obituary



Shri. Binu Philip Cherian, employee of Coconut Development Board, Kochi passed away on 15<sup>th</sup> July 2020. Shri. Binu, a native of Vakathanam, Kottayam, Kerala has been working in the Board since 1994. Shri. Binu Philip Cherian is survived by his wife Smt. Dincy Binu and daughter Linta Susan Binu and son Lohith Binu.

Coconut Board family deeply mourn the sudden and untimely death of Shri. Binu Philip Cherian.



1.37. B: C ratio remained higher than 1.0 in all the years which indicates that the model is consistent in generating better profits. Social relevance of the model in terms of employment potential was quite considerable with the generation of 85 man days from the model on yearly basis

By shifting to integrated farming approach, most of the nutritional demands of the household comprising of four adults could be satisfied. On an average 116 kg coconut oil, 2672 litres of milk, 142 kg fruits, 688 kg vegetables (including tuber crops)

and 140 kg fish could be obtained from the model annually. Surplus food production could be marketed in generating income.

It could be concluded that in the coconut based integrated farming system model, the components are judiciously selected and are of complimentary nature. Resource recycling is very well practiced within the system enabling less reliance on chemical fertilizers. Diverse food production contributes to family nutrition and the surplus is marketed in generating additional income. The model is consistent in yield performance and is profitable over the years. This model could therefore be adopted by farmers of similar agro-ecological tracts for food security as well as economic (doubling of farmer's income) and environmental benefits. This model, could be further scaled up through the integrated farming systems project (Jaiva Gruham) of the Kerala State Department of Agriculture Development and Farmers' Welfare, which forms part of the Subhiksha Keralam project of the State Government being technically supported by the Integrated Farming Systems Research Station, Karamana, Kerala Agricultural University, Thiruvananthapuram (0471-2343586). ■

## References:

1. Department of Economics and Statistics (2019). Tenth Agriculture Census 2015-16 (Provisional Report Phase I). Government of Kerala. p.70.
2. Heilig, G.K. (1993). Lifestyles and Energy Use in Human Food Chains. Working Paper. International Institute for Applied Systems Analysis A-2361 Luxenburg Austria
3. Coconut Development Board Statistics 2017-18 available at <https://coconutboard.gov.in/Statistics.aspx>

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## A successful innovative model for promoting value addition with emphasis on coconut

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The Regional Agricultural Research Station, Pilicode in Kasaragod district of Kerala, popularly known by its acronym RARS, is one of the oldest research stations in India. Established in the year 1916 by the erstwhile Madras state government as coconut research station, it has contributed immensely to the wealth of scientific knowledge on every aspect of coconut during the last one hundred and odd years. It was here that the world's first coconut hybrid was evolved four score and four years ago. Subsequently, numerous high yielding varieties have been evolved for which farmers from across the state and beyond throng the station in large swarms every year, during the month of June for buying the exceptionally coveted seedlings. The station has always been in the forefront of coconut research in the country for evolving science based solutions to the prioritised problems of the coconut farmers. One of the challenges faced by the coconut farmers is the declining or stagnating output prices compared to escalating input prices. The increase in the price of coconut over the last decade has only been marginal. Even the productivity of coconut is not significant in spite of the elaborate efforts made by the institutions concerned. Ravaged by climate change, scarcity of skilled labour, violently fluctuating prices and rampant pest and disease attacks, Kerala's coconut farmers are parables on agrarian distress in the country. The RARS, Pilicode of

Kerala Agricultural University, though until recently has been focussing more on developing production technologies, has come forward to address the current felt need of coconut farming sector with a set of value addition based initiatives as a research priority.

### Background

Value addition and product diversification has since long been recognised as the key to ensuring better income for the farming community and for the sustainability of farming in our country. However, value addition and product diversification activities in India is minimal, as low as 7% (Saikumar et al., 2010) as the process is constrained by various technological, infrastructural, institutional and policy factors. The picture in Kerala, the land of coconut, too is not rosier as elsewhere in the country. Kerala has not made tangible progress in value addition of coconut except for the traditional activities such as copra and oil milling and coir processing. Coconut based economy can expect a revival only when the profitability of coconut farming is delinked from the price behaviour of coconut oil through value addition and product diversification. By far, the most important reason for the tardy progress in coconut value addition sector is the lack of scalable cost effective technologies suitable for small and marginal enterprises.





Elements of the Value Addition Innovation Diffusion Model Developed by the RARS, Pilicode

Apart from generating and demonstrating technologies, the packaging and labelling of the value added product in its final marketable form and its business/sales potential to increase income need to be demonstrated. Then, the adoption of technologies generated will ensue naturally as a logical sequel resulting in establishment of value addition units in rural areas. This would create more local demand for raw materials which will fetch price to several hitherto underutilized/unutilized crops/produce and farmers will derive additional income. Finally the nation gets nutritive food products ensuring nutritional security apart from contributing to the GDP growth.

In this back drop, the scientists of the RARS Pilicode lead by its Horticulture Division made a brain storming to work out strategies and to arrive at a model for promoting value addition with special emphasis on coconut. It eventually led to the establishment of Centre of Excellence in Post Harvest Technology at the station. The project was sanctioned under a "Network Project on Value Addition and Post-harvest Management" in 2014-15. The centre is designed incorporating all the elements of the model conceptualised so that any willing farmer or entrepreneur among the visitors to the centre shall pick up the message, "It is possible, I can".

### Research: Ideation and Innovation Development

It involves generating ideas for innovative technologies and developing innovations for value addition and also packaging, labelling and branding. The innovations thus developed shall have following attributes i) High consumer acceptance ii) Scalable (Must be able to produce on a range from home scale to commercial level) iii) Raw materials shall be locally available, underutilized or non-utilized. The

project is implemented in the following sequence.

#### 1. Infrastructure Creation

The requisite infrastructure includes a pilot plant, lab facilities, machineries, sales counter and Food Pro Mall.

#### 2. Research on Product development

Protocols has been developed for value added products based on crop priority, availability and seasonality. The research, production, marketing etc shall be supervised and managed by a professionally qualified team of scientists and technicians. They shall receive feedback from consumers and entrepreneurs and make necessary changes and fine tuning in the innovations developed.

### 3. Mass Production and marketing

#### 3.1 Production

The bulk production of value added products shall be carried out by a Self Help Group, trained and groomed for the purpose.

#### 3.2 Sales and Marketing

The sales and marketing shall be through the sales counters and "Food Pro Mall" of the RARS and other KAU outlets.

#### 4. Extension

Impart training to the willing entrepreneurs both individuals and groups, display of the professionally labelled, packaged branded products in the Food Pro Mall as a permanent exhibition and sensitization based on the principle of "Seeing is Believing" and to infuse in the minds of every willing entrepreneur the confidence that 'I can'. It would give accurate experience based data on all aspects of enterprise and technological products including the production cost, revenue and cost benefit ratio. Besides this



Coconut Dehusking Machine



Coconut Desheller



Disintegrator



Screw press milk extractor



VCO Cooker



High Speed Centrifuge



Testa removing machine



Manual hydraulic press

all other extension channels are also used for accentuating the communication and spread of innovations.

### Centre of Excellence in Post Harvest Technology

The RARS could actualise the above model in a short span of time and accomplish the following components and activities as part of the Centre of Excellence in Post Harvest Technology, which is manned and managed by a professionally qualified team.

#### 1. Creation of Infrastructure

To begin with, a pilot plant and lab facilities with FSSAI registration was established in a built up area of 2000 sq ft after renovating an existing building. A semi mechanised processing facility for Virgin coconut oil (VCO) production with a capacity of 500 nuts/day was installed during 2014-15. These include machineries such as coconut dehusker, deshelling machine, testa removing machine, disintegrator, screw press milk extractor and tubular centrifuge worth Rs.15 lakh. More machineries worth Rs.20 lakh were procured in subsequent years from 2015 to 2017 which included micro filter, VCO cooker/uruli roaster, multipurpose milk juice expeller, coconut chips electrical slicer, vacuum dehydrator, vacuum packing machine, commercial wet grinder, mini grinding mill, multi-purpose fruit/vegetable cutter, electrical drier, automatic bottle filling machine and

a set of cashew nut processing machinery etc.

### Machineries in virgin coconut oil (VCO) production unit

#### 2. Research on product development

Initially the research activities were focussed on developing coconut kernel based products mainly on Virgin Coconut Oil (VCO). During 2014-15, besides VCO, other kernel based products such as coconut curry paste, chutney powder, coconut pickle etc. were standardised using minimum processing equipments. The raw materials used were entirely from the farms attached to the RARS. The research on product standardisation and diversification for new innovative downstream products was continued further during 2015-17.

**Products Developed:** Till date, the station has developed technologies for more than 50 value added products from various horticultural crops of which those from coconut is prominent. The technologies developed are virgin coconut oil (Hot & Cold process), and products from VCO such as Danthapala Oil (skin & hair care), mouthwash, face cream, hair cream, herbal hair oil, body lotion, coconut water based products such as syrup, vinegar, cider, honey, fizzy soft drinks, nata de coco, kernel based products such as defatted desiccated coconut, sweet ball, coconut chips (sweet, spicy & chocolate), chutney powder, coconut pickle, coconut curry paste

(sambar, chicken, channa and fish), coconut milk based products such as milk honey, milk chocolate, halwa, yoghurt, tender nut based products such as juice, pudding, ice cream, banana based chips, halwa, banana powder, cashew apple pickle, squash, jam, RTS, cashew nuts with different grades, papaya candy, jam, pickle, mango pickle, squash, bar, jackfruit halwa, amla candy, passion fruit squash etc.

### 3. Formation of SHG and operating production unit through revolving fund

A group of 10 members from among those successfully completed the training were selected exclusively based on their performance during the training to form and register a Self-help group "NANMA SWAYAM SAHAYA SANGHAM". They were enrolled as interns and inducted into the production unit on completion of a probationary period of 3 months. A MOU was signed between the SHG group and the Kerala Agricultural University for scaling up the production of value added products for which technology was generated from the station. The main raw materials such as coconut, jack fruit, cashew, papaya, mango etc are made available from the research station to the unit along with other inputs and the SHG members are involved in value adding them into specific research based products as directed by the centre. The products are sold through the sales counter at RARS Pilicode and other KAU outlets. The challenge before the RARS Pilicode in the beginning was to ensure an assured income to this SHG to sustain them in the production unit. This was made possible by offering one third of the income generated through sale proceeds based on the MoU between the centre and the SHG, which they share among the members on a monthly basis. This provides gainful employment and decent income regularly to the SHG members. The expenditure for running the unit is met from the revolving fund operated by RARS earmarked for the purpose, and the income generated is ploughed back into the revolving fund which helps to increase the revenue of the station.

#### 3.1 Mass production of Value Added Products

The value added products, developed by the Centre of Excellence in Value Addition at the RARS Pilicode and scaled up for commercial level production are briefly explained hereunder:

**Virgin Coconut Oil (VCO):** VCO is obtained from

fresh, mature endosperm (kernel) of the coconut by cold and hot processing methods. Virgin coconut oil is a major source of Lauric Acid and Vitamin E. Health benefits include protection from atherosclerosis and heart disease by increasing HDL, preventing obesity, as a hair and skin conditioner and for aroma therapy and as massage oil. A demonstration unit for production and training on Virgin coconut oil involving machineries has been established at the centre. The product is sold as Kera rathna Virgin coconut oil hot processed and cold processed in 500, 250 and 100 ml bottle packing.

**Danthapala oil:** A downstream re-innovated value added product from Virgin Coconut Oil and Danthapala (*Wrightea tinctoria*) leaves along with other herbal ingredients which has strong antifungal and antibacterial properties. It is developed in two formulations, one for hair and other for skin. It is useful in dermatitis, hair fall, psoriasis, dandruff, eczema and is a panacea for skin related disorders. It is sold in 100 ml bottle packing.

**Herbal hair oil:** This product is prepared from virgin coconut oil, and an extract of 9 herbs having hair care properties such as hibiscus, amla, henna, aloe vera, curry leaf, bhringraj, neelamari (Indigo), tulasi and other natural ingredients. It helps in hair growth, and effective against hair fall and dandruff. This is also sold in 100 ml bottle packing.



**Face cream:** Another innovated product from Virgin coconut oil and other natural ingredients such as beeswax, turmeric and Aloe vera. It helps in reducing pimples, acne, wrinkles, aging and stretch marks and soothes burns

**Mouth wash:** Downstream product from Virgin coconut oil along with components for oral hygiene such as oils of clove, cinnamon, cardamom, pepper mint and natural extract of mango leaves.

**Hair cream:** A completely natural





## ● Value Addition

product prepared from virgin coconut oil, bee wax, Aloe vera, amla, hibiscus leaves, tulsi and lavender oil. It helps in reducing excess hair fall, moisturizes hair and cleans scalp, brings shiny appearance, controls itching and grooms strong hair.

**Body lotion:** Another innovated product from Virgin coconut oil and other ingredients intended mainly for infants and babies. A completely natural cream prepared from virgin coconut oil, bee wax, aloe vera and other natural ingredients. It is a good skin moisturizer and promotes supple skin and protects it.

**Coconut water syrup:** Refreshing drink made from coconut water obtained from mature nuts while preparing VCO without losing the freshness. It is prepared using coconut water with equal amount of sugar, ginger, natural colour and citric acid as a preservative. This can be consumed after diluting 4-5 times with water.

**Coconut water vinegar:** A natural product derived from coconut water with sugar, fermentation by inoculation of yeast/ Acetobacter followed by addition of mother vinegar, oxidation and acidification. Natural vinegar is free from the hassles of synthetic vinegar prepared from commercial acetic acid which is harmful to health.

**Coconut water cider:** A fermented beverage standardized from coconut water through pasteurization and fermented using yeast as inoculums and further subjected to blending and filtration.

**Coconut chips:** Prepared from thinly sliced fresh coconut meat by slicing the meat into 0.6-0.7mm



thickness, blanching in boiling water, soaking in syrup, draining and drying in a dryer. It is standardized in 3 flavours, spicy, sweetened and chocolate. It is a ready-to-eat snack food rich in fibre.

**Coconut milk toffee:** Toffee developed from a combination of Coconut milk, virgin coconut oil, glucose, chocolate and jaggery.

**Coconut water honey:** A brownish viscous product standardized from coconut water rich in sodium and potassium, useful in healing wounds and utilized for further value addition.

**Coconut sweet ball:** Sweet ball prepared from fresh coconut meat, residue of VCO, virgin coconut oil, raisins, cardamom, jaggery and coconut milk. It is an excellent sweet which is healthy and relishing.

**Chutney powder:** Kerala's traditional cuisine prepared by using coconut kernel, spices, onion, salt and black gram. Chutney powder can be stored up to 6 months without refrigeration.





#### **Coconut pickle:**

Prepared by using fresh coconut meat into thin cubes, sesamum oil, spices, salt and vinegar.

#### **Coconut curry paste:**

A convenient food developed based on traditional Kerala cuisine for easy, fast cooking without any

preservatives. It is a ready to use stable product with long shelf life (one year or more), uniform quality for instant results. It is prepared from coconut kernel, Virgin Coconut Oil, salt, curry leaf and an ideal blend of spices. 50g of paste is sufficient for a family of 4 for a single preparation. 4 recipes are developed separately for chicken, fish, channa and sambar preparations

**Coconut cookies:** Tasty coconut cookies prepared from desiccated coconut powder, virgin coconut oil, flour (Maida/wheat/ragi), vanilla essence.

**Tender coconut Pudding:** A delicious dessert standardised from tender coconut water, meat, milk, china grass, essence and cashews with shelf life for one week.

**Tender coconut ice cream:** Prepared using combination of tender coconut water, tender coconut meat, coconut milk, condensed milk and sugar.

The mass production of value added products in coconut are based on zero waste concepts. The husk obtained while dehusking are utilised for burial in coconut plantation of RARS Pilicode. Coconut shells removed while deshelling is used as fuel source in cashew nut processing. The testa removed for production of VCO is dried and mixed with cattle feed and given to the dairy animals in the farm. The defatted desiccated coconut is value added to various products and sold. The Coconut water obtained while processing is also value added to

various products as explained. The remaining kernel wash water and coconut water is microbiologically processed, concentrated and enriched with nutrients and used for nursery plants and vegetables. Thus it is maintained as a zero polluting unit.

## **3.2 Marketing**

### **3.2.1 RARS, Sales Outlet**

The packed and bottled value added products are sold through the sales counter attached to the RARS Pilicode. For this purpose, the existing sales counter was renovated to give a facelift and stylish look to attract customers. Based on demand, the products are also sent to sales outlets of KAU located in different districts all over Kerala.

### **3.2.2 Food Pro Mall**

A Food Pro Mall was constructed incurring Rs.15 lakh with a built up area of 850 sq ft in the RARS Campus at Pilicode, which is situated on the Kozhikkode-Mangalore Highway. It has an octagonal shape and a beautiful architectural look of a modern shop marked by its attractive and stunning display of products. The food pro mall sell the branded value added products from the processing unit in its final marketing form, in attractive packing and labelling. It serves as a perennial, 'seeing is believing' source of motivation for the aspiring entrepreneurs, youth and women groups of the zone and beyond. Food Pro Mall has started to function in full swing with a variety of ready to eat and ready to serve food items prepared through value addition of coconut and other fruit crops of the region such as tender coconut milk shake, tender coconut pudding, ice cream, coco choco milk shake, coconut based fizzy drinks, amla juice with honey, and ginger with beetroot flavour, passion fruit juice etc. The Food Pro Mall attracts not less than 200 customers per day and it has become a favourite food joint for many and the customer base is expanding in fast progressions.

Analysis of the sales output based on product category reveals that VCO is the most sought after value added product in coconut. However more revenue is obtained through ready to drink (RTD) processed tender coconut juice made available from the food pro mall on an instant basis.

## **4. Training Programmes**

The centre conducts regular training programmes, based on the principle of 'learning by doing' to those interested entrepreneurs and self help groups, who are willing to take up the value addition in





coconut as an enterprise based on the RARS model. So far, 260 woman entrepreneurs in 30 batches and Kudumbasree members have been imparted training in batches of 10 members. The trainees were evaluated based on their performance after the completion of training and certificates were issued to them in a public function. The 'Nanma SHG' unit of the station play a crucial role in maximising learning experience to the trainees during the training process. The SHG imparts real experience to aspirant trainees and serve as a constant source of motivation to similar groups in setting up a value addition firm.

## 5. Transfer of Technology

Production protocol for certain novel technologies available with the centre are transferred to entrepreneurs on need basis, on payment of technology transfer fee fixed for different value added products from Kerala Agricultural University. They also will be provided practical training on the particular product. Technical advice and guidance is also provided to the potential entrepreneurs for setting up of coconut based processing units regarding machineries, quality specifications, marketing prospects etc., based on the data available with the centre.

## 6. Outcome and Impact

### a) Financial Achievements

The year wise income from the sales of value added products from food pro mall and sale counter of RARS, Pilicode is depicted in the graph below.

### Year wise income of RTS and value added products

There was a steady growth in revenue in 2019-20. Provided the existing rate of growth is projected, the

income can be expected to rise to around one crore per year with in another two years. Considering a capital investment of a total of 50 lakhs for the project including buildings, the projects become break even with in a period of 5 years which sounds very good.

### b) Adoption

Several entrepreneurs are inspired by the VCO plant established under the project and are convinced about the technical feasibility and profitability of such ventures. At least two units have been established in the district of Kasaragod and three units in Kannur district by the trainees.

## 7. Conclusion

From the experience so far, the RARS model has been proved successful in terms of the technologies generated for their suitability to microenterprise level, their output and outcome in terms of income and employment generation, consumer acceptance etc. The RARS, Pilicode could establish a strong foundation of value addition research for evolving novel products with attributes compatible with the agro climatic situation, market and consumer needs and preference of the region in coconut and other horticultural crops. The model, besides offering novel technologies could also successfully demonstrate the risks involved, possible constraints and the hurdles to be crossed in achieving success in the venture. The centre has succeeded in instilling confidence among intrested entrepreneurs to start value addition enterprises at micro level or even at commercial level. The trainings and demonstrations conducted also facilitated awareness and adoption fulfilling almost all the objectives of the project.

A robust supporting system and linkages encompassing technical, infrastructural, financial, marketing and regulatory environments are also required to enable the aspiring entrepreneurs to gauge the opportunities and launch a new company in coconut value addition sector. Aspiring entrepreneurs can ideally come forward to embark on coconut value addition as a remunerative business considering the enormous potential and opportunities available in the sector. It is our sincere hope that the model evolved and demonstrated by us is worth replicating in Kerala.

Source: \*Saikumar, B.C., Manjunatha, A.V., Chengappa, P.G., and Nagaraj. 2010. "Value addition in agriculture and allied sectors," *Journal of Global Economy, Research Cetre or Social Sciences, Mumbai, India*, 6(4), 311-327. ■





## Yummy Coconut Products Growing Demand in US Markets

**Remany Gopalakrishnan**

CEO, Onattukara Coconut Producer Company Ltd, Kattanam, Alappuzha, Kerala

There has been a constant demand for food items from the world over, considering the incessant increase in population. Coconut, a magical fruit, which provides food security, has therefore, assumes growing significance and is on the increasing demand globally. This growing significance of coconut is not only as a food crop but also as a multiple provider of a variety of products and by products like oil, milk, cream, water, fibre, shell and many more. Diversified applications of coconut products in pharmaceutical, nutraceutical and cosmaceutical segments drive the demand on a wider scale. There is a growing acceptance for the existing and emerging coconut-derivatives which have impacted the markets positively. Rising application of coconut oil and milk in a variety of products is anticipated to further fuel the overall market. Besides, newer coconut products are introduced at a faster rate around the world to make products more competitive. Increasing awareness on the benefits associated with the products coupled

**India has the potential to send novel coconut products to different market destinations as a major market player. The country can compete with other major producers in products supply. Many small and medium industrial units are manufacturing competitive quality coconut products which can be exported after identifying the markets.**



with growing demand from major developed countries such as Europe and North America is expected to drive the demand. These products have therapeutic properties which are made use of in the development of health care, body care and beauty care products. The food and beverage and cosmetic industry are attempting more R&D efforts to harness full benefits of coconut to enhance their product range. Indonesia, Philippines, India, Sri Lanka, Brazil, and Vietnam are the major producers of coconut. These countries are also the major suppliers to US and Europe. Philippines and Indonesia are the major producers and exporters of coconut oil. United States is one of the major importers of coconut oil owing to its high domestic demand.

This article portrays the experience of the author on her visit to some of the US markets, before the onset of COVID-19. Her long service in the Coconut Development Board, Government of India and the present assignment

as the CEO of Onattukara Coconut Producer Company, Alappuzha District, Kerala, rekindling its interest in coconut market. Onattukara Company is a Farmer Producer Organization (FPO) formed under the initiative of Coconut Development Board, Government of India. The Company manufacture quality coconut oil along with many other value added products viz., urukku velichenna (Oil from coconut milk), desiccated coconut powder, coconut chutney, coconut cookies, chips, ginger mix, stew mix, squash, coconut pickles etc. and marketed in Onattukara brand.

### Coconut in US Markets

The food products shelves in the chain markets in Dallas, Houston and Austin in the State of Texas are full of coconut products and ready to eat coconut dishes from various countries. The display of variety of coconut products in a country like America was an overwhelming experience for a coconut loving visitor from India. Coconut in different forms, ie.,



whole dehusked coconut, coconut oil, virgin coconut oil, coconut milk, milk powder, tender coconut water, frozen gratings and pieces, variety of coconut based food preparations, confectioneries, and coir fibre products are the wide range of products list. This multiple product scope explicit the vast potential of coconut in international markets. This state of affair offers immense opportunities to Indian coconut farmers.

Dehusked whole coconut, grated coconut, frozen fresh slices, partially dried coconut chips etc. serve the purpose of fresh coconut. Whole coconuts are





of fresh nut requirement of Malayalee population. Besides, Sri Lankan and Thai coconut oil and grated coconut are also available in plenty. Coconut milk too, serves the purpose of fresh nut use in culinary purposes and confectioneries. Coconut milk is widely used in cosmetic and food & beverage industries. It is also widely used as an effective alternative to dairy products. It has become increasingly popular, owing to its high nutrient content and is likely to witness high growth in the future. Desiccated coconut is used as a substitute for grated coconut in various food preparations and baked food. Virgin coconut oil a product that made market entry initially from Thailand and Philippines has now on strong footing in international markets. Its application segments are diverse and immense. VCO has wider use in pharmaceuticals, cosmeceuticals, nutraceuticals.

Tender coconut water is packed in cans and in tetra packs. The demand for coconut water as a natural energy drink is growing rapidly due to its nutritional

properties such as electrolytes and nutrients. Thailand's product is the pioneer in this sector. India has also made entry in this sector. According to @Technavio, one of the most influential market research and advisory firm, the Coconut Water Market in US will grow by \$ 2.19 billion during 2020-2024 and the packaged coconut water market size has the potential to grow by USD 3.88 billion during the same period.

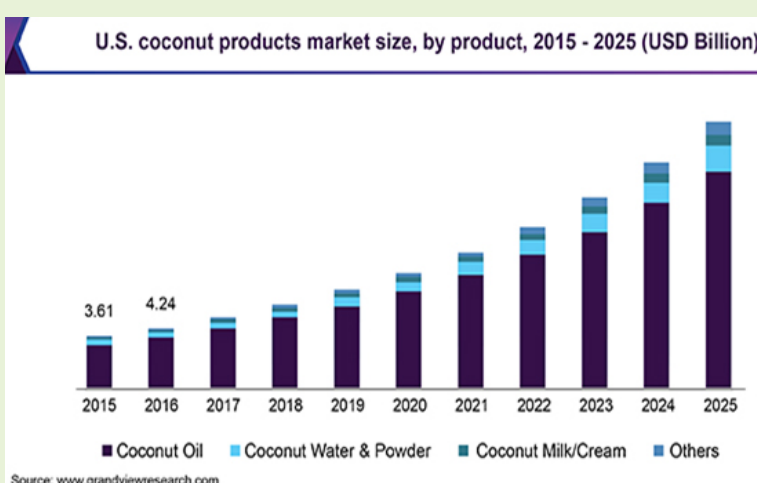
Beauty care products are hitting the cosmeceutical market. The benefits of coconut oil for hair and skin is widely used in a range of cosmetic and personal care products such as hair oils and soaps. Apart from lauric and myristic acid in coconut oil, many other fatty acids like capric, caprylic, palmitic, stearic, oleic, and caproic are used in beauty care products. The rise in demand for coconut oil in the cosmetics industry is likely to drive the market for coconut products globally. Coir products have already acclaimed acceptance as natural biodegradable products. It is the raw material for geotextiles and

also sold out to cater to the need of offerings and puja purposes, besides fresh nut use. Coconut oil of various brands from Kerala, Sri Lanka, Thailand, Vietnam etc packed in wide mouth bottles are targeted for consumers using coconut oil for edible purpose. Since coconut oil solidifies below 23-24°C temperature, wide mouth bottles are preferred in USA. Many brands viz., Vita Coco coconut oil, Viva coconut oil, nutiva coconut oil and different brands of coconut oil in spray bottle share the shelves with Kerala's brands, KPL Sudhi, KLF Nirmal, Coconad etc.

Frozen grated coconut from Kerala meets the lions' share



A market study on global coconut products elucidates the growing demand for coconut products due to its diverse applications in various existing and emerging utility sectors. The Global products market was classified into coconut oil, coconut water, desiccated coconut powder, coconut milk/cream and others. According to the study the global coconut products market size was estimated at USD 30.38 billion in 2018 and is expected to register a CAGR of 17.8% during 2015-2025. (Source: Grandview Research Inc.). Coconut oil and virgin coconut oil are beneficial for skin and hair and this drives the demand from personal care and beauty care applications. Similarly, coconut milk is gaining popularity as an alternative to dairy milk, especially among vegan population. Other derivatives like coconut water, sugar, and desiccated coconut powder are gaining popularity due to the health benefits associated with them. Coconut water is gaining popularity as energy drink due to its natural hydrating properties. Desiccated coconut is used widely in bakery items, vinegar in food industry as a healthier alternative to synthetic vinegar as a preservative or flavoring agent. Products like coir is also expected to witness increased demand due to their diverse applications in geotextiles due to its impressive durability and absorbent characteristics and eco friendliness. Such diverse uses of coconut products are anticipated to further fuel the demand from countries like Europe and US in the forthcoming years. Increasing consumer awareness about these applications is expected to fuel the overall growth.



has attained popularity as a medium in horticulture and floriculture. Coir is widely used for making ropes, floor mats, brushes, doormats, and mattresses. All these diverse uses open new vistas to Indian coconut sector. The opportunities that are opening up to our farmers are immense. Whole sale merchants-cum-exporters and retailers from Kerala who made their presence are Parayil Exports (Daily Delight), Nilamel Foods, Eastern, Brahmins, Mezhukkattil, KLF, KPL etc. Products from Sri Lanka, Thailand, Indonesia, Philippines, and India and Vietnam find prominent places. Kerala dominate in the Indian products supply especially in frozen ready to eat food items.

Keralites relish coconut cuisines than any other food items. In their veg and non-veg dishes different forms of coconut form the major ingredient. Fresh grated coconut or coconut milk adds more taste to most of the breakfast items and their side dishes. Their popular non-veg dishes like fish curry, fish biriyani, beef coconut fry, mutton stew, mutton biriyani, etc find place in all the food shelves of the super markets and are sold out as hot cakes as gathered from their bill desk. The taste and affinity of Vegan food have also been catered to in different

ways. All preferred and traditional vegetables like banana spadix, tender jack fruit, jack fruit seed, variety of leafy vegetables etc are cooked in coconut and packed frozen as ready to use dishes. Gravy dishes like aviyaal (cooked mixed vegetables in fresh coconut) onion and bitter guard theeyal (A dish in fried coconut and spices) are common. Among the confectioneries, chocolates, cookies, candies, sweet and hot dried fruits-mix, and toffees made out of coconut powder, desiccated coconut or coconut milk as major ingredients are lip-smacking.

We cannot imagine a growing demand or sale of these varietal food items in US markets, if their quality is inferior. Organic is the most attractive GSP in international markets. Chemicals and pesticides free products are placed at top priority. Products without organic label are difficult to get entry into super/ hyper markets. Organic products are fetching premium price and have niche markets. People all over the world are conscious on pesticides and chemicals residue. Organic foods have a significantly high rate of growth in demand over the conventional foods. These foods compounds with biologically active components under different names pharma



In this COVID-19 era, immunity boosting is the health tip. The lauric acid in the coconut oil is a factor which contributes immunity to human body and strengthens the defensive mechanism. Lauric acid content in human breast milk imparts nourishing and protecting care to babies. Similarly coconut oil rich in lauric acid play a vital role in building our immune system by getting converted it into monolaurin. Coconut represents saturated fat consisting of medium chain fatty acids (MCFAs). Scientists have recognized MCFAs for their anti bacterial and anti viral properties. The lauric acid and capric acid are MCFAs and are immediately absorbed in the body instead of storing them as fat. The latest edition of Journal of Association of Physicians (JAPI) has carried a review on immunomodulation benefits and antimicrobial ability of coconut oil which revealed that saturated fatty acids are the right source of fats needed for the body's metabolism. Coconut oil can therefore form the ingredient of many health products which can fight against bacteria and virus.

foods, phyto foods, therapeutic foods etc are believed to have salutary impact on improving health and wellness. Marketing networks like Costco, B-Mart, Grand Mart, Giant, Shoppers, HEB, Shoprite, Well Mart, Wall Mart, San club - all are actively engaged in sale of coconut products. The number of coconut consuming population is increasing and therefore the potential is huge and our farmers should be equipped to take advantage of the same. Though COVID-19 calamity might have shaken the US markets in a serious manner, a country like America is believed to have the potential to come out of the shock within a shortspan of time.

### India Equipped for capturing International Markets

India is capable of sending more and more products into the international markets. The Coconut Development Board under the Ministry of Agriculture, Government of India had made maiden efforts in this direction. The concerted efforts and initiatives of Coconut Development Board fueled the development of innovative products. Product diversification and byproduct utilization has made strong footing in the country in the last two decades. Until then coconut was utilized as the main commercial source of coconut oil besides domestic consumption. Only a small fraction was utilized for processing and value addition. The price of coconut was mainly dictated by the price of coconut oil.

In 1990s, the declining and fluctuating price of coconut oil compelled the policy makers to introduce a shift in the hitherto followed utilization pattern of coconut. It was necessitated to focus on product diversification and byproduct utilization of coconut. Coconut Development Board established a

Technology Development Centre (TDC) as a first step and a line of products were developed. Packaged tender coconut water, Coconut cream, spray dried coconut milk powder, coconut chips, vinegar, nata de-coco, neera and its downstream products are a few among the lot. Thus the message of products development and setting up of coconut based industries got popularized. Schemes for assisting the entrepreneurs technically and financially were drawn up and introduced by the Board. This gave an impetus to the coconut sector and a variety of coconut based industrial units cropped up across the southern states where coconut is available in plenty. This changed scenario had rewritten the destiny of coconut sector and the price of coconut and its products started moving up and stabilized. Indian coconut farmers are now getting better price than their counterparts in other major growing countries. The TDC has now grown up into CDB Institute of Technology (CIT) with NABL accredited Laboratory.

Now India has the potential to send novel products to different market destinations as a major market player. The country can compete with other major producers in products supply. Many small and medium industrial units are manufacturing competitive quality products which can be exported after identifying the markets. Expansion of organized retailing has been instrumental in driving the growth of the market. That is also happening in the country. Thus there is tremendous scope for our products and the sector is expected to grow leaps and bounds in a short span of time. Coconut ensures livelihood security, food security, social security, health security and nutritional security to human beings. Coconut will continue to serve the humanity to cater to all these needs. ■

# “Initial impact of COVID-19 pandemic on coconut sector”

Coronavirus disease 2019 (COVID-19) pandemic has become the greatest threat to global public health, economic growth, environment, and the social life of people in many countries. The pandemic is severely disrupting the global economy due to the temporary lockdown and shut down of the business. Lockdown has caused an increase in unemployment, a reduction of productivity, a potential drop in consumer's expenditure, and an increase of government expenditure in the non-productive sector.

Owners of most companies had to reduce their workforce to maintain the social distancing and other protocols issued by the governments to prevent transmission of the diseases. The export and import of the many coconut values added products are on a decreasing trend from the last three months. Lockdown has caused temporarily reduced demand for specific products. The growth of significant sector ruined due to the COVID-19 pandemic is of daily workers attached to different streams like roadside vendors selling food items, including the tender coconut sellers.

The extent of the impact of COVID-19 on coconut sectors might vary among the type of industry, countries, and regions. Some non-food industries, such as activated carbon and briquette, are facing a relatively low impact of COVID-19. However, a prolonged period of the pandemic might affect the supply of raw materials to the industry. Domestic consumption of value-added coconut products, mainly coconut oil, comparatively increased, especially household consumption. The increase of coconut oil household consumption, and virgin coconut oil demand amid COVID-19 could be caused by the promotions on the potential of VCO against COVID-19, and some testimonies of hospitalized COVID-19 patients who were recovered due to the inclusion of VCO in addition to the standard treatment they received in the hospital.

The International coconut community (ICC) is conducting an online survey of the impact of COVID-19 pandemic on coconut sectors. Farmers, manufacturers and traders from coconut producing countries are participating in the survey. Moving forward, the data collected and analyzed might allow for the generation of evidence-based advocacy to mitigate the impacts of pandemics, and lesson learned for pandemic preparedness. We hope that through active participation of all and the implementation of appropriate measures, the pandemic could be contained quickly to sustain coconut farmer livelihood and to recover the global economic slowdown.



DR. JELFINA C. ALOUW  
Executive Director, ICC

Source: *The Cocommunity* Vol.50, No. 06, 2020



# Nisarga:

## The strongest tropical cyclone struck the coconut ecosystem of Maharashtra State

V.V. Shinde<sup>1\*</sup>, H.P. Maheswarappa<sup>2</sup>, S.L. Ghavale<sup>3</sup>, R.G. Khandekar<sup>4</sup> and S.R. Mahaldar<sup>5</sup>

Severe Cyclonic Storm Nisarga was the strongest tropical cyclone to strike the Indian state of Maharashtra in the month of June since 1891. It was also the first cyclone impact to Mumbai since cyclone phyan of 2009. The third depression and second named cyclone of the annual cyclone season, Nisarga originated as a depression in the Arabian Sea and moved generally northward. On 2<sup>nd</sup> June, the India Meteorological Department (IMD) upgraded the system to a cyclonic storm, assigning the name Nisarga. On the next day, Nisarga further intensified to a severe cyclonic storm and turned to the northeast, ultimately making landfall approximately 95 km south of Mumbai. Nisarga strongly hit on 3rd June and dissipated on 4<sup>th</sup> June. Nisarga was the second

cyclone to strike the Indian subcontinent within two weeks time, after Cyclone Amphan, the first super cyclonic storm to have formed in the Bay of Bengal in the 21<sup>st</sup> century, devastated the state of West Bengal in May 2020. Making landfall in Maharashtra with winds of 110-120 km/h (70 mph), Nisarga became the strongest storm to strike the state in the month of June since 1891. Before Nisarga, only two depressions had struck Maharashtra in 1948 and 1980 respectively.



**Impact** - In Alibaug, close to where Nisarga made landfall, recorded a wind speed of 102 km/h (63 mph), while nearby Murud-Janjira seen a wind speed of 111 km/h (69 mph) as the Cyclone was strongest at its south southwest section. State Capital Mumbai seen a wind speed of 50-60 km/h. It's remnant gave heavy to very heavy rain on the foothills of Eastern Nepal and adjoining Bihar. Nisarga barrelled through Alibaug with 130 km/h. The barrage alisted for two hours before the storm weakened and moved north. By then, around 1,00,000 hours work partially damaged. Countless coconut and areca nuts palms were flattened. The Raigad and some part of Ratnagiri district lost power and phone connectivity. The major roads connecting affected talukas and major national and state highways.

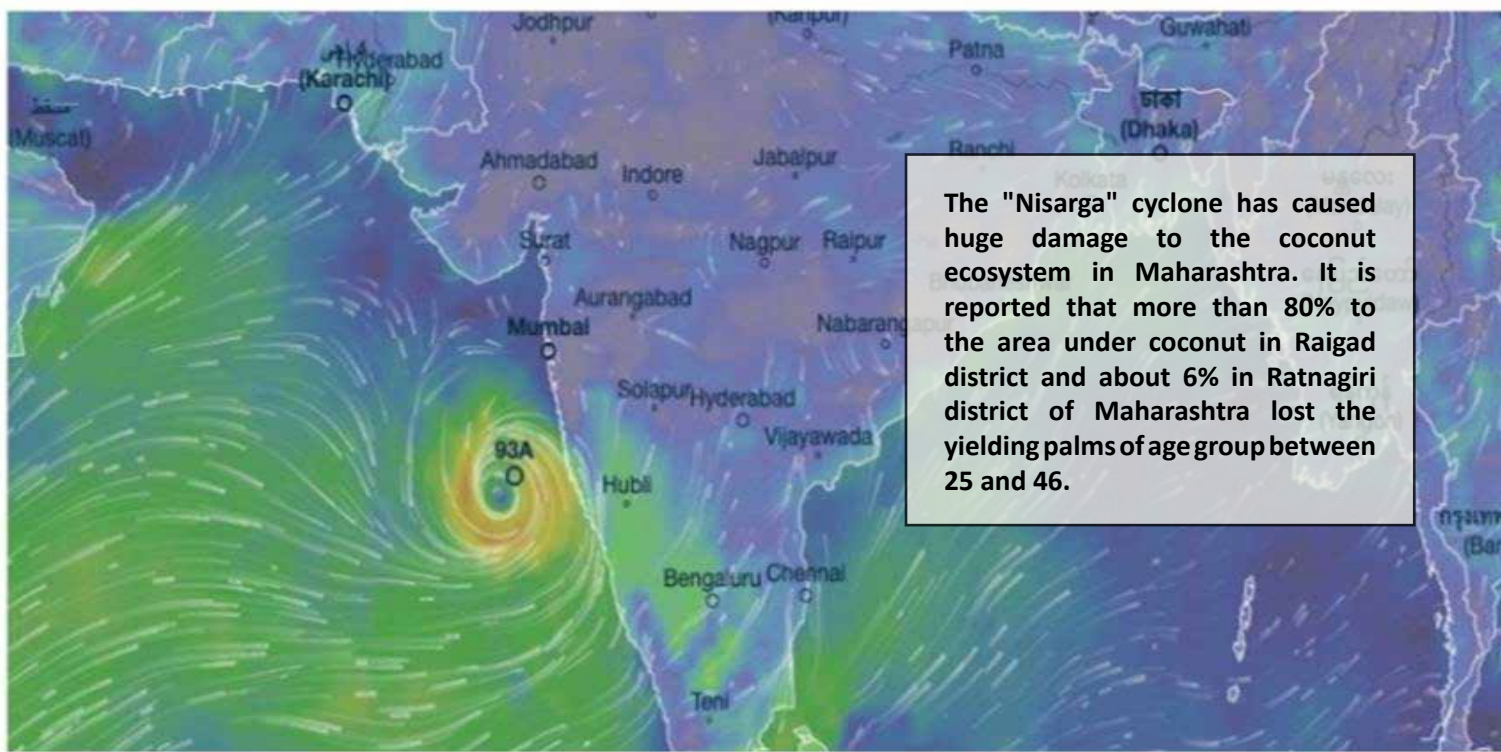
A committee was constituted by Ministry of Agriculture and Farmers Welfare to assess the damage caused by the cyclone. In this regard, a field team was constituted with a representative from each organization consisting State department of Agriculture, State department of Horticulture, State agricultural university (BSKKV, Dapoli), Coconut Development Board, State Centre Thane. Field team visited the severely affected villages in the districts of Ratnagiri and Raigad. The area for sample survey was finalized in consultation with the Department of Horticulture, Maharashtra based on the damage to coconut crop in that area.

The team visited Diveagar village, Shrivardhan

Taluk of Raigad and Murabi village, Dapoli Taluk of Ratnagiri on 23<sup>rd</sup> and 24<sup>th</sup> of June 2020, respectively to conduct the sample survey. The team also had discussion with all the committee members through video conference during their field visit which provided an opportunity to view the damage through the live streaming and also to interact with the farmers. The field team enacted as the eye(s) and ear(s) of the committee in undertaking the field visit and their efforts were commendable for the cooperation extended for undertaking the assessment within the time schedule in such a pandemic condition. The field team received the representations from farmers of the sampled area. The farmers represented for electrical/ petrol operated chainsaw for cleaning and requirement for hybrid seedlings. Besides, financial assistance to the tune of Rs. 2.00 lakh per ha is also requested by the farmers.

### Loss assessment due to Nisarga cyclone in Maharashtra

The team visit to the farmer's field in Diveagar village, Shrivardhan Taluk of Raigad and Murabi village, Dapoli Taluk of Ratnagiri were conducted on 23<sup>rd</sup> and 24<sup>th</sup> of June 2020, respectively to undertake sample survey of damage caused to coconut crop due to Nisarga cyclone. Field team informed that the percentage of crown damage is more in Raigad while the percentage of damage for uprooting is more in Ratnagiri District of Konkan region.







Sample survey undertaken by the field team  
Five gardens each in both the districts were visited by the team and the consolidated report is as follows;

Raigad (23.06.20)						
Sr.No.	Name and Address of the Farmer	Area (acre)	Total no. of Palms	No. of palms damaged		
				Uprooted	Crown damaged full	Crown damaged partial
1.	Shri. Manvendra Kamalakant Kulkarni	2.42	688	488	98	102
2.	Shri. Mulidhar Sakaram Shilkar	0.67	374	168	111	95
3.	Shri. Viendra Anant Kulkarni	1.16	148	77	54	17
4.	Shri. Vinayak Narayan Joshi	2.42	142	64	63	15
5.	Shri. Ratnakar Sakharam Shilkar	0.61	49	13	33	3
Total		7.28	1401	810	359	232

Ratnagiri (24.06.20)						
Sr. No.	Name of Farmer	Area (acre)	Total no. of Palms	No. of palms damaged		
				Uprooted	Crown damaged full	Crown damaged partial
1.	Shri. Sharad Ganesh Pendase	0.28	68	54	9	5
2.	Shri. Pramod Laxman Mehandale	0.68	78	67	6	5
3.	Shri. Prakash Bhaskar Paranjape	1.17	218	194	11	13
4.	Shri. Viresh Govind Zagade	2.42	23	18	5	0
5.	Shri. Suresh Laxman Pendase	0.62	68	58	6	4
Total		5.17	455	391	37	27

Sr. No.	Name of Farmer	Area (acre)	Total no. of Palms	No. of palms damaged		
				Uprooted	Crown damaged full	Crown damaged partial
1.	Raigad	7.28	1401	810 (58)	359 (26)	232 (17)
2.	Ratnagiri	5.17	455	391 (86)	37 (8)	27 (6)
	Total	12.45	1856	1201 (65)	396 (21)	259 (14)

Figures in parenthesis is percent value





Preliminary damage report				
Sl. No.	District	Total area under coconut (ha)	Affected area (ha)	% area affected
1.	Raigad	3784	3060	80.86
2.	Ratnagiri	5672	313	5.51
	Total	9456	3373	35.67

(Reported by DOH, Maharashtra)

From the report it is to be assumed that 81% of the coconut growing area in Raigad district is affected by the cyclone but in Ratnagiri it is 6 % of the total area.

### Field Observations reported by the team

- Great loss to coconut plantation towards west coast of Maharashtra (2720 ha).
- The palms are spaced very closely and intercropped with Arecanut and spices.
- Cutting of uprooted and broken palms is in progress in the area.
- Advice was provided to farmers for necessary care to protect the coconut from Rhinoceros beetle and Red Palm weevil (RPW) infestation due to pile up of uprooted palms.
- Necessary guidance was provided for cleaning and collection of immature fallen nuts and other remaining.

### Technical recommendations

- It is important that the plants that were completely uprooted and decapitated have to be removed from the gardens as a means of field sanitation. The fallen trunks and boles of the palms, if allowed to remain in the fields, will serve as breeding sites for the major coconut pest i.e., rhinoceros

beetle and red palm weevil.

- It is important that the slanting/bending bearing palms should not be disturbed;

- Depending on the extent of disturbance of the root system earthing up near the bole region followed by compaction may be done. Young palms below 6 to 8 years age that are bent have to be put back to position and earthing up at the base should be done.

- The twisted spear leaf and its surrounding leaves should be cut six inches below the twist and the fibre wrapping the petioles of these fronds should be longitudinally split so as to release the tension caused due to twisting. The cut bases of these leaves should be thoroughly drenched at the earliest with copper oxychloride 0.3 % (3 g per liter) or Bordeaux mixture @1 % as prophylactic measure to prevent chances of bud rot disease infection. Wherever the farmers are apprehensive about climbing atop the crowns of slanting palms, drenching with fungicide may be done with the help of high pressure power sprayers.

### CONCLUSION

The "Nisarga" cyclone has caused huge damage to the coconut ecosystem in Maharashtra. It is reported that more than 80% to the area under coconut in Raigad district and about 6% in Ratnagiri district of Maharashtra lost the yielding palms of the age group between 25 and 46. This is the need of the hour to help the farmer for rejuvenation of the existing gardens with good agriculture practices to improve the growth and yield of palms. ■

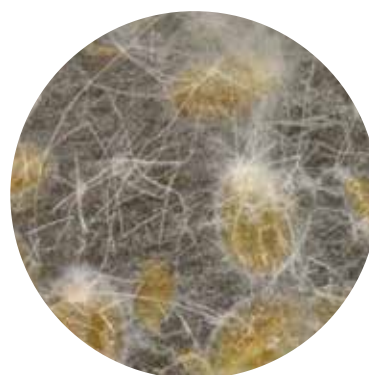
# Isaria fumosorosea:

## a Potential Biocontrol Agent for Management of Rugose Spiralling Whitefly

Sumalatha, B.V., Selvaraj, K\*, Poornesha, B and B. Ramanujam  
ICAR-National Bureau of Agricultural Insect Resources, Bengaluru

Coconut is cultivated throughout the tropics where it is interwoven into the lives of the people and also provides a variety of products. Pest problem is one of the major constraints for achieving higher production and productivity in coconut. Coconut witnessed four exotic whiteflies viz., rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus*, Bondar's nesting whitefly (BNW), *Paraleyrodes bondari*, nesting whitefly, *P. minei* and palm infesting whitefly, *Aleurotrachelus atratus* within a span of two years in India (Selvaraj *et al.*, 2016; Selvaraj *et al.*, 2019). Among invasive, RSW is more dominant and spread across the Kerala, Karnataka, Tamil Nadu and coastal districts of Andhra Pradesh, Assam, West Bengal, Goa, Gujarat, Telangana, Meghalaya and Lakshadweep on coconut and many other palm plants (Selvaraj *et al.*, 2017; Selvaraj *et al.*, 2019). Rugose spiralling whitefly is an invasive pest native to Central America and was first discovered in Florida in 2009. This pest attacks on more than 120 host plants but prefer to feed on Arecaceae family.

Rugose spiralling whitefly nymphs and adults feeds aggressively on leaf sap results in depletion of nutrients and water which leads to premature leaf drop and it produces wax and sticky honeydew on infested areas leading to extreme growth of black sooty mold which results in the reduction of photosynthetic efficiency in palms. It has now become regular pest of coconut, warranting control measures to avoid crop losses.

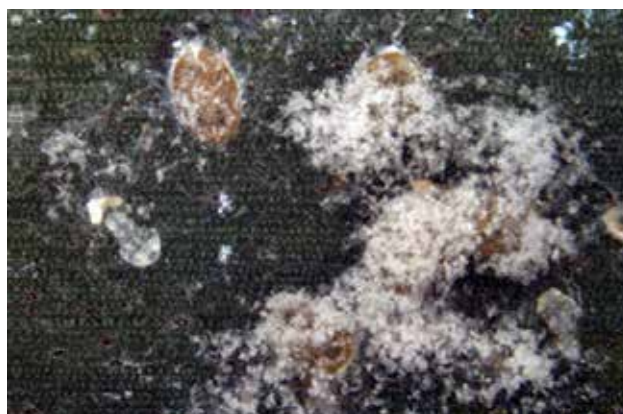


**Rugose Spiralling Whitefly is an invasive pest native to Central America and was first discovered in Florida in 2009. This pest attacks on more than 120 host plants but prefer to feed on Arecaceae family.**

Invasive species pose a constant threat to agriculture and a strategic science-based approach is needed to promote environmentally sustainable plant health management practices to reduce excessive reliance on chemical pesticides. Biological control through parasitoids and predators constitutes a significant component in holistic management of insect pests. As a joyful celebration of nature, the United Nations General Assembly declared 2020 as the “International Year of Plant Health” to “Adopt environmentally friendly pest-management practices, including those based on biological approaches that do not kill pollinators, and beneficial insects and organisms.”

So far, augmentation, redistribution and conservation strategies for the potential parasitoid *Encarsia guadeloupae* like avoiding chemical pesticides and habitat manipulation through intercropping of Canna india and banana is recommended for the management of this pest in India. *E. guadeloupae* was found to be most abundant and its natural parasitization was recorded to the extent of 60-82% on coconut and other crops (Selvaraj *et al.*, 2017). Lack of uniform distribution of *E. guadeloupae* and absence of parasitoids for other invasive is matter of concern. In search of an alternative management strategy, entomopathogenic fungus *Isaria fumosorosea* (ICAR-NBAIR Pfu-5) seems effective against all life stages of RSW. This fungus is reported and being used as potential biocontrol agent against many whiteflies viz., *A. rugioperculatus* and *Paraleyrodes bondari* on coconut (Ali *et al.*, 2015; Kumar *et al.*, 2016 & 2018), *Singhiella simplex* on ficus (Avery *et al.*, 2019) in Florida. Thus, the present study was proposed to evaluate the efficacy of *I. fumosorosea* (ICAR-NBAIR pfu-5) against RSW in coconut.

Laboratory and field experiments were conducted with ICAR-NBAIR isolates of *I. fumosorosea* (Pfu-5) with five concentrations and tested on different RSW life stages. Fungal culture was produced on sterilized rice grains, talc and oil-based formulation. Spore suspension was prepared by suspending formulation at 5 g or ml/L in sterile distilled water containing 0.01% Tween 80. The suspension was filtrated through double layers of muslin cloth to get hyphal-free spore suspension and the concentration of the spore in the suspension was adjusted to  $1 \times 10^8$  spores/ml using Neubauer's improved haemocytometer. Mortality/hatching inhibition of eggs, first instar, second, third instar nymphs and pupae were recorded and statistically analysed the



*Isaria fumosorosea* infection on *Aleurodicus rugioperculatus* nymphs



Re-distribution and augmentation of *Encarsia guadeloupae* in Andhra Pradesh

percent reduction. To integrate the *I. fumosorosea* with *E. guadeloupae* to develop the bio-intensive pest management, the effect of this fungus on development of *E. guadeloupae* in RSW nymphs and adults were assessed.

The experimental results showed that *I. fumosorosea* exhibited excellent pathogenicity against all the developmental stages of *A. rugioperculatus* (Fig.1). The sporulation of the *I. fumosorosea* on eggs, early and late instar nymphs and adults of RSW was observed at 48 hours after treatment. Though *I. fumosorosea* not treated on adult, mortality /mycosis and deformation was observed in the adult emerged from treated nymphs. The Pfu-5 strain showed 35.2 to 99.6 % mortality on the different life stages of RSW at concentration of  $1 \times 10^8$  spores/ml after 5 days of treatment. Least LC50 values  $2.3 \times 10^4$  of *I. fumosorosea* was recorded for first instar nymphs of RSW with least LT50 values 41.39 hrs under laboratory condition. Significantly higher suppression and lower the LC50 and LT50 values indicate the higher virulence against RSW life stages. The impacts of *I. fumosorosea* on the





*Isaria fumosorosea* infection on *Aleurodicus rugioperculatus* nymphs and adult



parasitoid showed the inhibition of adult emergence was much lower in the Pfu-5 strain (5.8-19.6%) at a concentration of  $1 \times 10^8$  spores/mL at different exposure time.

Based on laboratory results, large scale field validation of this entomopathogen (pfu-5) was carried out in Karnataka, Andhra Pradesh, Kerala and Tamil Nadu. The fungal suspension was prepared at  $2 \times 10^8$  spores/ml, applied using high volume sprayer (5-7 litre of spray solution /palms along with tween 80). The results revealed that overall cumulative reduction to the extent of 72% in RSW population after 30 days and minimum two sprays advocated at 15 days intervals for reducing the pest population below damaging level. The results of present study suggest that the application of pfu-5 was found to be highly pathogenic and seems to be potential biopesticide against of all different life stages of RSW with very slight negative effects on beneficial parasitoid, *E. guadeloupae* and no infectivity on *Dichochrysa astur* and *Goniozus nephantidis*. These two biocontrol agents are compatible with each other; hence they can be utilized together in biointensive pest management programme for the control of RSW coconut ecosystem. In addition to efficacy, *I. fumosorosea* is considered as natural mortality agent, safety for humans and other non-target organisms, reduction of pesticide residues, preservation of other natural enemies and increased biodiversity in managed ecosystems.

ICAR-NBAIR supplied this entomopathogens to different stakeholders such as Indian institute of Oil Palm Research, Dr YSR Horticultural University, Tamil Nadu Agricultural University and Department of Horticulture, Andhra Pradesh for the large-scale mass production and field demonstration for the



Foliar application of *I. fumosorosea* on coconut

management of this invasive whitefly on coconut and other crops. Beside supply of isolate, hands on training on cost effective mass production techniques was provided to different stakeholders and farmers, department officials. Besides, ICAR-NBAIR initiated extensive studies on effective and ideal formulation technology for this entomopathogen for higher bio-efficiency, long shelf-life, and higher persistence with financial assistance from Coconut Development Board, Kochi. ■

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### References

- Ali AD, Harlow JL, Avery PB, Kumar V (2015) Investigating the role of fungal entomopathogens in whitefly landscape IPM programs. J Entomol Sci 50(3): 254–261
- Alma CR, Goettel MS, Roitberg BD, Gillespie DR (2007) Combined effects of the entomopathogenic fungus, *Paecilomyces fumosoroseus* Apopka-97, and the generalist predator, *Dicyphus hesperus* on whitefly populations. Biocontrol 52: 669–681
- Avery PB, Faull J, Simmonds MSJ, (2004) Effect of different photoperiods on the growth, infectivity and colonization of Trinidadian strains of *Paecilomyces fumosoroseus* on the greenhouse whitefly, *Trialeurodes vaporariorum*, using a glass slide bioassay. J Insect Sci 4:38
- Avery PB, Jane Faull J, Simmonds MSJ (2008) Effects of *Paecilomyces fumosoroseus* and *Encarsia formosa* on the control of the greenhouse whitefly: preliminary assessment of a compatibility study. BioControl 53 (2): 303-316, DOI.org/10.1007/s10526-007-9073-5
- Kumar V, Francis A, Avery PB, McKenzie CL, Osborne LS (2018) Assessing Compatibility of *Isaria fumosorosea* and Buprofezin for mitigation of *Aleurodicus rugioperculatus* (Hemiptera: Aleyrodidae): An invasive pest in the Florida landscape. J Econ. Entomol 111 (3): 1069–1079
- Kumar V, McKenzie CL, Osborne LS (2016) Effect of buprofezin and *Isaria fumosorosea* against rugose spiralling whitefly. Arthropod Manag Tests DOI: 10.1093/amt/tsw099, P. 1–2
- Luangsa-Ard JJ, Hywel-Jones NL, Manoch L, Samsonbc RA (2005) On the relationships of *Paecilomyces* sect. *Isarioidea* species. Mycol Res 109 (5): 581-589
- Selvaraj K, Gupta A, Venkatesan T, Jalali SK, Ballal CR, Sundararaj R (2017) First record of invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) along with parasitoids in Karnataka. J Biol Control 31 (2): 74-78, DOI: 10.18311/jbc/2017/16015.
- Selvaraj K, Sumalatha BV, Venkatesan T, Shylesha AN (2018) Biological control of invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin in India. In: Abstract book of national symposium on Entomology 2018: Advances and Challenges held at Professor Jayashanker Telangana State Agricultural University, Hyderabad during 10-12th December, 2018, P 85
- Selvaraj K, Venkatesan T, Sumalatha BV, Kiran CM (2019) Invasive rugose spiralling whitefly *Aleurodicus rugioperculatus* Martin a serious pest of oil palm *Elaeis guineensis* in India. J Oil Palm Res, 31(4), 651-656, DOI:org/ 10.21894/ jopr.2019.0052.
- Selvaraj K, Sundararaj R, Venkatesan T, Ballal CR, Jalali SK, Gupta A, Mrudula HK (2016) Potential natural enemies of the invasive rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin in India. J Biol Control 30(4): 236-239, DOI: 10.18311/jbc/ 2016/ 15598
- Sundararaj R, Selvaraj K (2017) Invasion of rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae): a potential threat to coconut in India. Phytoparasitica 45: 71-74
- Zhou F, Ali S, Huang Z (2010) Influence of the entomopathogenic fungus, *Isaria fumosorosea* on *Axinoscymnus cardilobus* (Coleoptera: Coccinellidae) under laboratory conditions. Biocontrol Sci Technol 20: 709–722
- Zimmermann G (2008) The entomopathogenic fungi *Isaria farinosa* (formerly *Paecilomyces farinosus*) and the *Isaria fumosorosea* species complex (formerly *Paecilomyces fumosoroseus*): biology, ecology and use in biological control. Biocontrol Sci Technol 18(9):865-901, DOI.org/10.1080/0958315080247181



# Cultivation practices for coconut-August

## New planting

Plant the coconut seedlings after the cessation of the monsoon in low lying areas subject to inundation during monsoon.

## Incorporate green manure legumes into coconut basin / interspace

Green manure crops sown in the coconut basin or in the interspace of coconut gardens have to be incorporated into the soil if they have attained 50% flowering. In the coconut basin the green manure, legumes can be incorporated by using a spade. If tractor is used for incorporating the green manure in the interspace of coconut garden, care should be taken to avoid injury to the coconut trunk.

## Nursery management

If sufficient moisture is not available due to insufficient rainfall, continue irrigation for the seedlings in the nursery until rains set in to provide sufficient moisture. Weeding has to be done wherever necessary.

## Drainage

Wherever water logging is experienced provide



drainage channel to drain the excess water. If continuous heavy rain occurs, make raised bunds around the planting pits newly planted with coconut seedlings to avoid entry of water into the pits.

## Manuring

In rainfed areas, circular basins of 1.8 m radius and 25 cm depth may be dug during the fag end

of August and green leaf or compost or farm yard manure may be spread at the rate 50 kg per palm basins. The remaining two-third of the recommended dose of fertilizers may be spread over the green leaf or compost and covered. Application of 500 g N, 320 g  $P_2O_5$  and 1200 g  $K_2O$  per palm per year is generally recommended for adult plantations. To supply two-third of the above nutrients it is necessary to apply about 0.67 kg urea, 1 kg rock phosphate (in acidic soil) or 1.4 kg Super Phosphate (in other soils) and 1.35 kg of Muriate of potash (MOP). Wherever boron deficiency is observed borax can be applied @100 g/palm. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided.

## Moisture conservation practices

Most of the coconut growing tracts in the country received less than average monsoon showers during this season. The month of June recorded 40-50% less rainfall compared to the average. Same trend is being



observed during July also. The erratic behaviour of south-west monsoon indicates the significance of conserving each drop of water received. Depending upon the topography and soil type the following soil and moisture conservation practices can be adopted in coconut gardens.

## Mulching

In order to conserve soil moisture in the coconut plantations, mulching with various types of organic materials can be practiced. The best time for mulching



is before the end of the monsoon and before the top soil dries up. For mulching, cut coconut leaves into two or three pieces. To cover 1.8 m radius of coconut basin, 10 to 15 fallen coconut leaves are required



and can be spread in two to three layers.

Mulching with composted coir pith to 10 cm thickness (approximately 50 kg/palm) around coconut basin is also an ideal method to conserve moisture. Coir pith can hold moisture five times its weight. Due to its fibrous and loose nature, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil. The applied material may last for about 1 to 2 years. Coconut husks are also used as surface mulch around the base of the palm. It can hold moisture to the tune 3 to 5 times of its weight. Approximately 250 to 300 husks will be required for mulching one coconut basin. Mulching is usually done up to a radius of 2 m leaving approximately 30 cm near the palm. Two layers of husk may be buried in the coconut basin with the concave side facing upwards. These layers facilitate absorption of moisture. Above this, another layer of coconut husk is placed with the convex side facing upwards to arrest evaporation. Effect of this mulch lasts for about 5-7 years.

## Husk burial

Burial of husk in trenches in between the rows of palms is also effective for moisture conservation in coconut gardens. Husk burial is to be done at the beginning of the monsoon, in linear trenches of 1.2 m width and 0.6 m depth between rows of palms with concave side of husks facing upwards and each layer is to be covered with soil.



## Catch pit filled with coconut husk



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

## Contour trench filled with coconut husk

This measure is to be taken up where the land slope is high. Trenches of 50 cm width x 50 cm depth and convenient length are to be

made in between two rows of coconut palms. These trenches are to be filled with coconut husk. Coconut



husks need to be filled in layers with the bottom



layers facing up and top layer facing down. A bund of 20 cm height and suitable width (>50 cm) is made at the downstream using the excavated soil. Two layers of pineapple plants are to be planted on the bund with a spacing of 20 cm x 20 cm. Pineapple plants would stabilize the bund and provide additional income to the farmer. The runoff water from the upper side would be collected in the trenches. Soil particles would also get deposited in the trench along with the runoff water. Coconut husk retains the moisture and makes it available for plants during summer months.

### Half-moon bund around coconut basin reinforced with pineapple

This measure is to be taken up where there is mild slope (15-20%). Here a flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil



at the downstream side. After making the basin, a bund of 30 cm height and >50 cm width is made at the downstream side of the coconut using the excavated soil. Two layers of pineapple plants could

be planted with a spacing of 20 cm row to row and 20 cm plant to plant on the bund. The bund prevents runoff and water gets collected within the basin and percolates down. Pineapple would help to protect the bund and stabilize the same in addition to giving fruit yield.

### Plant protection

August marks the transition phase between the two monsoon periods. Since the quantum of monsoon showers had dropped significantly, there is more emergences of sucking pests in this phase, especially the coried bug and spiralling whiteflies. Extreme care should now be focussed on the early diagnosis of coreid bug incidence as this pest causes a greater damage on the nut yield potential in different parts of the country more specifically in the Southern Kerala. In areas where rugose spiralling whitefly was not reported so far, this pest could emerge as well for which greater emphasis is laid on biological control. Greater emergence of the killer disease, bud rot is more visible in this part of the year for which adequate prophylactic measures need to be undertaken to tackle this problem. Weakening monsoon showers as well as weather dynamics favoured a major shift in the pest and disease kinetics invading coconut, and therefore warrants systematic monitoring and timely prophylactic measures.

### Pests

#### ► *Rhinoceros beetle (Oryctes rhinoceros)*

Being a ubiquitous pest, the incidence of rhinoceros beetle is quite common during all periods however its damage is well pronounced during monsoon phase when seedlings are also planted. In seedlings just planted, the spear leaf gets damaged and distorted by beetle damage. Juvenile palms are also prone to pest attack and sometimes appearing as elephant tusk-like symptoms. Damaged juvenile palms are stunted and get delayed in flowering. Of late incidence of nut boring symptoms are also noticed. Moreover, the attack by rhinoceros beetle would invariable incite egg laying by red palm weevil as well as entry of bud rot pathogen in this period.

#### Management

- Prophylactic treatment of top most three leaf axils with either botanical cake [Neem cake /marotti cake / pungam cake (250 g)] admixed with equal volume of sand or placement of 12 g naphthalene balls covered with sand.
- Routine palm scrutiny during morning hours along





Life stages of the pest



Nut damage



Elephant-tusk like symptom



Metarhizium packets

with brushing of teeth and hooking out the beetle from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.

- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.
- Dairy farmers could treat the manure pits with green muscardine fungus, *Metarhiziumanisopliae* @ 5 x 10<sup>11</sup> /m<sup>3</sup> to induce epizootics on the developing grubs of rhinoceros beetle. Area-wide farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.
- Incorporation of the weed plant, *Clerodendron infortunatum* to the breeding pits caused hormonal irregularities resulting in morphogenetic transformational aberration in the immature stages of the pest.
- Crop diversity induced by intercropping and ecological engineering principles would disorient pests and provide continuous income and employment as well.

### White grub, *Leucopholis coneophora*

This subterranean pest feeds on the roots of coconut and cause yellowing of leaves, premature nut fall, delayed flowering, retardation of growth and reduction in yield. Since grubs are hidden in soil,



symptom diagnosis is very crucial in the identification of pest damage. Grubs initially feed on organic materials, roots of grasses and intercrops before

feeding on the palm roots. Adults emerge from the soil during the month of June. The pest is very severe in certain sandy belts of Kasaragod, Kerala and parts of Karnataka.

### Management

- Repeated summer ploughing to expose the immature stages for predation
- Handpicking of adult beetles during evening of two weeks commencing from the onset of monsoon.
- Application of neem cake in the palms basin @ 5 kg /palm for regeneration of roots.
- Soil application of aqua suspension of entomopathogenic nematode, *Steinernemacarpocapsae* @ 1.5 billion/ha and need based repeated application

### Rugose Spiralling Whitefly (*Aleurodicus rugioperculatus*)

This period could also witness the establishment of the invasive rugose spiralling whitefly (*Aleurodicusrugioperculatus*) in new areas as well as re-emergence in already reported areas. Presence of whitefly colonies on the lower surface of palm leaflets and appearance of black coloured sooty mould deposits on the upper surface of palm leaflets are characteristic visual symptoms of pest attack. In severe cases, advancement in senescence and drying of old leaflets was observed. Leaflets, petioles and nuts were also attacked by the whitefly pest and a wide array of host plants including banana, bird of paradise, *Heliconia* sp. were also reported.

### Management

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms
- No insecticide should be used as this causes resurgence of the pest and complete kill of the





*Rugose spiralling whitefly Parasitized pupae*



*Encarsia guadeloupae* Sooty mould scavenger beetle



natural aphelinid parasitoid, *Encarsia guadeloupae*. A pesticide holiday approach is advocated for the build up of the parasitoid.

- Installation of yellow sticky traps and conservatory biological control using *E. guadeloupae* could reduce the pest incidence by 70% and enhance parasitism by 80%.
- Habitat preservation of the sooty mould scavenger beetle, *Leiochrinus nilgirianus* could eat away all the sooty moulds deposited on palm leaflets and cleanse them reviving the photosynthetic efficiency of palms.
- A close scrutiny should be made for the presence of other whiteflies including the nesting whiteflies on coconut system.

### Coreid Bug, *Paradasynus rostratus*

Nymphs and adults puncture the meristematic regions of tender buttons (1-3 months old) injecting toxin around the feeding site causing necrosis. Feeding punctures develop into necrotic lesions and these spindle-shaped depressions could be visible when the perianth of shed button is removed. Female flowers are attacked prior to pollination and such flowers get dried and can be seen attached to inflorescence on the crown resulting in production of barren buttons. Most of the infested buttons and

tender nuts shed down. Retained nuts on the bunch develop furrows and crinkles on their husks and are malformed. In many cases gummosis can be seen on such

### Management

- Crown cleaning to destroy eggs and immature stages of the pest
- Spraying of azadirachtin 300 ppm (Nimbecidene) @ 0.0004% (13 ml / l) reduced the pest incidence at the highest level. Two rounds of azadirachtin spray on young coconut bunches 1-5 months old during May-June and September-October are quite essential for satisfactory control of the pest in the field
- Among the natural enemies, the weaver ant, *Oecophylla smaragdina* found to be the most efficient predator of coreid bug in the field.
- Two egg parasitoids, namely *Chrysocalcissa oviceps* and *Gryon homeoceri*, were identified as potential egg parasitoids. Forty per cent parasitism was observed in the egg mass collected from the field due to these parasitoids.
- Spraying chlorantraniliprole 0.3 ml/litre or lambda cyhalothrin @ 1.0 ml/litre on the pollinated bunches was found effective.

## Disease

### Bud rot or immature nut fall (*Phytophthora palmivora*)

In certain humid locations bud rot occurred regularly killing hundreds of trees. In India, bud rot incidence is recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or spindle turns brown and bends down. The affected spear leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Temperature range of 20- 24°C and relative humidity of 98% - 100% were found optimum for the development of the bud rot disease. Contiguous occurrence of such “favourable days” during rainy seasons determines the development of the disease and the intensity of infection. As *Phytophthora* diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.



### Management

- Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence. For the newly planted seedlings also prophylactic spraying of Bordeaux mixture (1%) can be given to avoid infection. In localities where heavy wind is experienced and leaves of coconut palms got damaged, spraying of Bordeaux mixture (1%) is essential to prevent infection by *Phytophthora*.
- Field sanitation and provide proper drainage during rainy season.
- Placement of two *Trichoderma* (*Trichoderma harzianum* CPTD28 isolate) enriched coir pith cakes in the inner most leaf axils just before the onset of monsoon and again after every two months as prophylactic measure.
- In disease affected palms, remove the entire rotten portion of the spindle by cutting with a sharp knife and apply 10% Bordeaux paste to the wound and cover with polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.

As envisaged, timely monitoring and prophylactic measures are very critical to safeguard palm health and provide optimum nut yield. Protection is therefore the key strategy to boost up productivity and double farmer's income. ■

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# Market Review – June 2020

## Domestic Price

### Coconut Oil

During the month of June 2020 the price of coconut oil opened at Rs. 15500 per quintal at Kochi, Rs. 15500 per quintal at Alappuzha market and Rs. 16000 per quintal at Kozhikode market. The price of coconut oil at these three markets expressed an overall upward trend.

The price of coconut oil closed at Rs. 15900 per quintal at Kochi market and Rs. 15900 per quintal at Alappuzha market and Rs. 16100 per quintal at Kozhikode market with a net gain of Rs.400, Rs.400 and Rs.100 per quintal at Kochi, Alappuzha and Kozhikode market respectively.

The prices of coconut oil at Kangayam market in Tamilnadu, which opened at Rs. 12533 per quintal, and closed at Rs.13000 with a net gain of Rs. 467 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.06.2020	15500	15500	16000	12533
06.06.2020	15500	15500	16000	12667
13.06.2020	16000	15900	16300	13333
20.06.2020	15900	15900	16000	13600
27.06.2020	15900	15900	16100	13000

### Milling copra

During the month, the price of milling copra opened at Rs.9600 per quintal at Kochi, Rs.9550 per quintal at Alappuzha market and Rs.9400 per quintal at Kozhikode market. The price of Copra at Kochi Alappuzha and Kozhikode market expressed an upward trend during the month.

The prices closed at Rs.10000 per quintal at Kochi market and Rs.9950 per quintal at Alappuzha market Rs. 9950 per quintal at Kozhikode market with a net gain of Rs.400, Rs.400 and Rs.550 per quintal respectively.

At Kangayam market in Tamilnadu, the prices opened at Rs. 8500 per quintal and closed at Rs.9000 per quintal with a net gain of Rs.500 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
01.06.2020	9600	9550	9400	8500
06.06.2020	9600	9550	9500	8700
13.06.2020	10100	9950	10000	9000
20.06.2020	10000	9950	9800	8900
27.06.2020	10000	9950	9950	9000

### Edible copra

The price of Rajpur copra at Kozhikode market opened at Rs. 11500 per quintal expressed a downward trend during the month and closed at Rs.10700 per quintal with a net loss of Rs.800 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.06.2020	11500
06.06.2020	11400
13.06.2020	11000
20.06.2020	10800
27.06.2020	10700

### Ball copra

The price of ball copra at Tiptur market which opened at Rs.8900 per quintal expressed an upward trend and closed at Rs.9500 per quintal with a net gain of Rs.600 per quintal during the month.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
01.06.2020	8900
06.06.2020	9500
13.06.2020	9200
20.06.2020	9500
27.06.2020	9500

### Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.9900 per quintal and expressed an upward trend during the month. The prices closed at Rs.10500 per quintal with a net gain of Rs.600 per quintal during the month.

\*NR-Not reported



Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.06.2020	9900
06.06.2020	9900
13.06.2020	10200
20.06.2020	10100
27.06.2020	10500

### Coconut

No report was received from Nedumangad market during the first four weeks of the month. During the last week of the month the prices reported was Rs. 15000 for 1000 nuts.

At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.11000 per thousand nuts and closed at Rs. 13000 during the month with a net gain of Rs 2000 per thousand nuts.

At Bengaluru market, the price of partially dehusked coconut opened and closed at the same price and it shows a mixed trend during the month.

At Mangalore market, the price of partially dehusked coconut was not reported during the month.

Weekly price of coconut at major markets (Rs /1000 coconuts)				
	Neduman-gad	Pollachi	Banglore	Mangalore (Grade -1)
01.06.2020	NR	11000	16500	NR
06.06.2020	NR	11000	18500	NR
13.06.2020	NR	12000	18500	NR
20.06.2020	NR	12000	16500	NR
27.06.2020	15000	13000	16500	NR

## International price

### Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
06.06.2020	171	177	260	334
13.06.2020	173	177	260	361
20.06.2020	173	158	297	361
27.06.2020	173	158	295	381

\*Pollachi market



### Coconut Oil

The domestic price of coconut oil in Sri Lanka expressed a downward trend during the month. Whereas domestic price of coconut oil in Philippines and Indonesia expressed an overall upward trend during the month. The international price expressed a mixed trend during the month under report.

The price of coconut oil quoted at different international/ domestic markets are given below.

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US\$/MT)	Domestic Price(US\$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri Lanka	India*
06.06.2020	918	834	825	2750	1694
13.06.2020	924	860	855	2727	1783
20.06.2020	921	856	855	2720	1819
27.06.2020	917	860	860	2682	1739

\* Kangayam

### Copra

The domestic price of copra at Sri Lanka expressed an overall downward trend whereas the domestic price of copra in Indonesia and Philippines expressed an overall upward trend during the month. The price of copra quoted at different domestic markets are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
06.06.2020	572	496	1537	1164
13.06.2020	593	528	1512	1204
20.06.2020	584	547	1474	1190
27.06.2020	589	562	1502	1204