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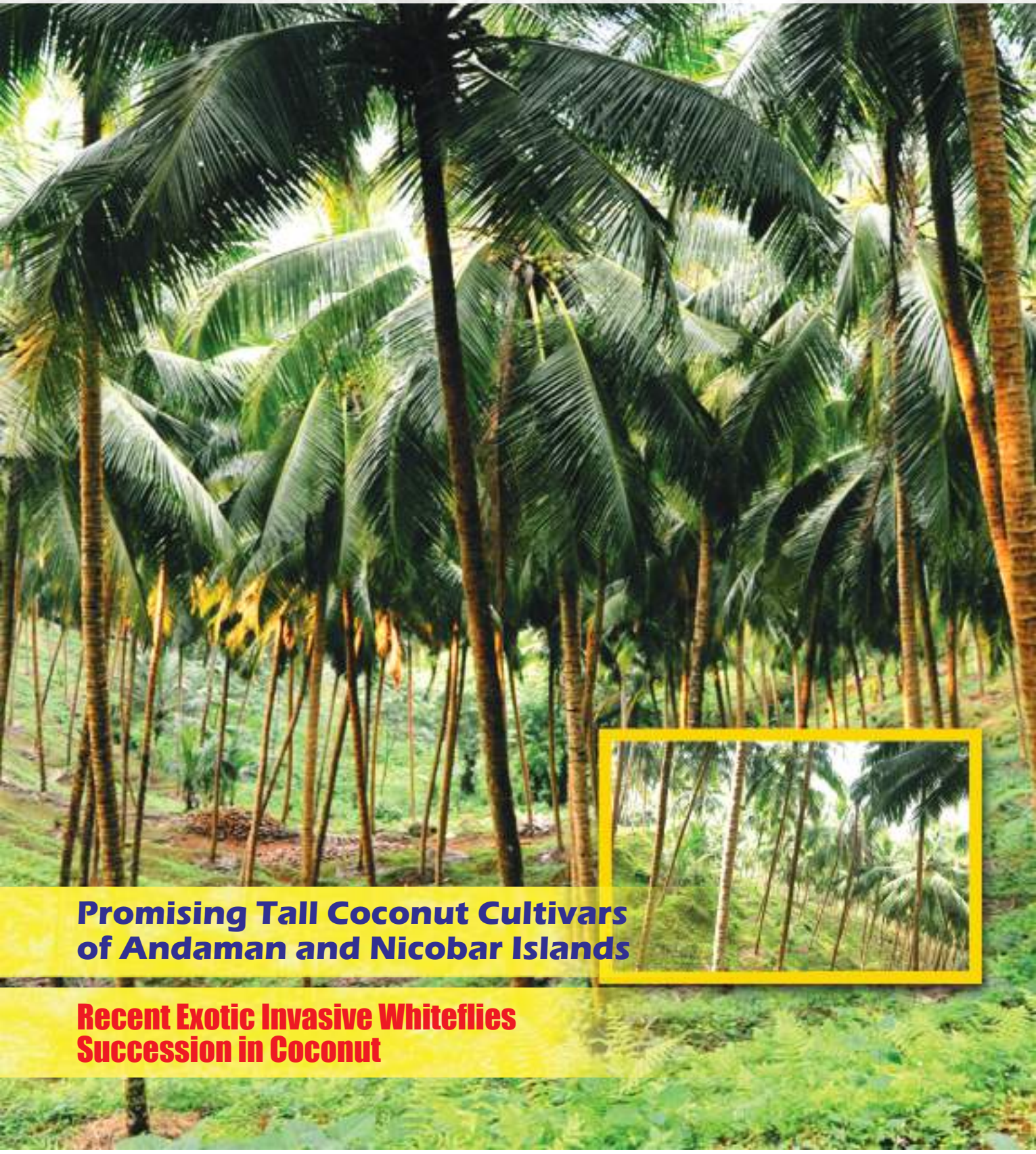

Promising Tall Coconut Cultivars of Andaman and Nicobar Islands

Recent Exotic Invasive Whiteflies Succession in Coconut

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Coconut Development Board

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

Functions

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

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

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

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Message from the Chairman's desk

Dear Readers,

A new year and a new beginning, a new adaptation to the new normal created by the pandemic; the market also motivated the stakeholders for new ideas and innovations because the prices of coconut, copra and coconut oil which started falling from the fag end of November 2021 continued through the new year. The Minimum Support Prices for season 2022 announced by the Government of India at Rs. 10590/- per quintal for milling copra and Rs. 11000/- per quintal for ball copra came at the right time and procurement at MSP is the ray of hope for the small holder coconut farmers. The State Governments in the major coconut producing areas are in the process of initiating procurement at MSP under the Price Support Scheme.

It is necessary to move with a clear vision for inclusive growth in the coconut sector in order to overcome distress sales during price falls. The versatility in its utility makes coconut a wonder crop which provides a refreshing drink, a yummy cocktail and a healthy beverage; supports a vegan diet, supplements health and immunity and provides a healthy sweetener; provides oil, fibre and minerals and vitamins; by-products provide fibre, growing medium, charcoal, water and air purifiers, capacitors and what not; the list is very lengthy and the potentials are enormous. The efforts of the Board in promoting processing and product diversification in coconut since 2002 have led to the establishment of a viable processing industry with the establishment of 535 processing units contributing to an additional processing capacity of over 3600 million nuts per annum.

The pandemic has taught us that we have to not only think globally and act locally, but also think locally too. Community based business models in integrated coconut processing with participation of small, medium and large processing enterprises will help in diversifying the product array and meeting the challenges towards developing a stable and sustainable enterprise. The concepts of one district one product and district as export hubs are stepping stones towards building this sustainable enterprise.

Let us work together to face the challenges and use proven models encompassing diversity and equity, sustainability, inclusion and stakeholders partnership to triumph and take the coconut sector to greater heights.

Rajbir Singh IFS

Chairman

Promising Tall Coconut Cultivars of Andaman and Nicobar Islands

B. Augustine Jerard, V. Damodaran, I. Jaisankar and S. K. Zamir Ahmed
ICAR-Central Island Agricultural Research Institute
Port Blair, Andaman and Nicobar islands

Introduction

The Andaman and Nicobar Islands in Bay of Bengal comprises of about 572 Islands and islets falls under the humid tropics with an average rainfall of over 3000 mm in about 139 rainy days with 78 % humidity and with mean maximum and minimum temperature of 30^{o}C and 23^{o}C, respectively. The soil type of A&N Islands ranges from sandy clay to sandy loam. The soil and climatic conditions are highly suited for cultivation of various plantation and spice crops such as coconut, , cashew nut, rubber, black pepper, and tree spices. Coconut and arecanut are the predominant plantation crops of these islands among which coconut is the predominant crop grown in Andaman and Nicobar Islands occupying an area of about 20000 ha out of the total 46000ha under agriculture. It plays a major role in the livelihood of people in these islands particularly the Nicobari tribes hence considered as the backbone of Island agriculture. The vast population of the native tribes and other settlers in A&N islands rely on coconut farming along with spices, tuber crops and fruits for their livelihood besides the marine capture fisheries. Coconut has been associated with the socio-cultural life of the people of these islands. The productivity of coconut in these Islands is 5888 nuts/ha as compared to the national productivity of 10122 nuts/ha. Limited management practices, lack of timely replanting of senile / dead palms, use of unselected planting material, lesser adoption of basin management and soil and water conservation measures are considered some of the reasons for low productivity in several locations.

The average coconut productivity of these islands is ranging from 30 to 45 nuts per palm at different islands whereas, at few places it exceeds more than 100 nuts per palm per year. However, remarkably high yielding individual palms are also noticed throughout these coconut populations amidst average or marginally yielding palms highlighting the importance of selection of mother palms for quality planting material production. Most of the coconut plantations in Andaman Islands are with selected planting material whereas the groves in Nicobar are filled with naturally regenerating diverse types. There is a need to use better cultivars and improved varieties to achieve better productivity at such places. Most of the coconut plantations in Andaman and Nicobar Islands consist of tall group of palms preferred for copra production whereas the dwarfs are grown in households and in urban areas for tender coconut purpose.

The popular tall coconut types from the Islands viz., Andaman Ordinary Tall, Andaman Giant Tall, Katchal Tall, Auck Chang Tall, Campbell Bay Tall and Tamaloo Tall are preferred for planting. These are well known among the farmers which have been collected, conserved and characterized by ICAR-CIARI, Port Blair. Besides, Andaman Ranguchang Tall is also well known for fruit yield. Selections have been made from Andaman Ordinary Tall and Andaman Giant Tall and released as improved varieties in other coconut growing mainland states Tamil Nadu, Kerala, Karnataka by research organizations such as Tamil Nadu Agricultural University and ICAR-CPCRI, Kasaragod with the names VPM 3 and Kalpa Dhenu, respectively.The details on the popular tall cultivars of these Islands are given here.

Andaman Ordinary Tall

It is the largely cultivated tall coconut cultivar in Andaman Islands, popularly known for attractive large fruits and sturdy palms. The palms of this cultivar exhibit robust growth habit with strong and stout stem with a well noticeable bole at the base of the stem which produces strong dark green leaves. The leaf drooping trait of Andaman Ordinary Tall is categorized as intermediate. The fruits are large, oblong shaped with husk thickness of about 2 to 3 cm. The husked fruits are round or oval, thick shell of over 4 mm with kernel thickness over 1.3 cm. The individual palms of this population show variation for fruit colour unless selected for particular colour. The fruit colour varies from dark green to light green or light brown. However, the predominant fruit

colour is green and shades of green. The palms of Andaman Ordinary are considered drought hardy, withstand heavy winds but takes longer time for first flowering when compared to other tall cultivars. The copra content ranges from 180 to 250g per nut with oil recovery of about 65%. The fruit yield per palm/year ranges from 50 to 150 depending upon the management conditions. The cultivar has also been reported as having tolerance to nematodes under field conditions. Although the tender coconuts are also used for drinking purpose, it is mostly utilized for copra making, processed coconut kernel products such as desiccated powder etc and VCO production.

Andaman Giant Tall

The palms of this type occur sporadically among the Andaman Ordinary population. Careful selection of mother palms and seedlings is important to establish a new plantation of Andaman Giant Tall. As the name implies, the fruits of Andaman Giant are large, round to oblong shaped, weighing over 5 to 8 kg at tender fruit stage. The husked fruits are also larger than Andaman Ordinary Tall, mostly globular. The kernel is thinner than Andaman Ordinary Tall, but the cavity volume is over 300 ml in matured fruits. The tender nut water content ranges from

350 to 600ml depending upon the stage of maturity and individual palms. The average tender coconut water per fruit is about 300ml. The palms possess dark green leaves, fruits are predominantly green with less proportion of palms with brownish fruits. The cultivar is preferred as a tender coconut cultivar by many traders as the larger fruits could be used to attract the customers to the tender nut parlor. The palms are robust growing with strong and stout stem with a prominent bole at the base of the palms, intermediate drooping of leaves. The palms of Andaman Giant are considered drought hardy, withstand heavy winds. The copra content ranges from 200 to 400g per nut with oil recovery of about 64%. The average copra content is over 240g per nut. The fruit yield per palm year ranges from 40 to 90 depending upon the management conditions. The palms are relatively moisture stress tolerant. A better performing selection made from Andaman Giant has been released by ICAR-CPCRI as 'Kalpa Dhenu' which is popular in the mainland which gave mean yield of 86 fruits per palm per year with the copra out turn of about 20kg per palm per year. Although the tender coconuts are also used for drinking purpose, it is mostly preferred for copra making, processed coconut kernel products and VCO production.

Auck Chang Tall

It is a popular cultivar of Car Nicobar Island from Nicobar district. Generally, the palms are morphologically similar like Andaman Ordinary Tall but with differences in nut characteristics. An accession collected and evaluated at World Coconut Germplasm Centre (WCGC) at Port Blair has shown that the palms of Auch Chang Tall cultivar are robust, high yielding (more than 100 nuts per palm/year) with higher copra content. The kernel is thick and recorded higher milk recovery under VCO production process through fermentation method. The fruits are green or light brown, husk thickness is thin (2 to 3 cm), husked fruits are oval, good tender nut water quantity (560 ml per fruit), average fruit weight over 1700g with average copra content of about 170g. However, there are palms with copra content of more than 260g recorded in the population. The oil content is about 65%. Under the natural habitat of rainfed conditions in Car Nicobar, the palms exhibited large bole, stout stem, good fruit setting with estimated fruit yield of over 140 nuts per palm per year, regular production of bunches and dense crown. There are no major pests recorded in this population. Careful mother palm selection followed by seedling selection is important to establish good plantation of Auck Chang Tall considering the variability observed in the natural and conserved population.

Katchal Tall

It is a cultivar of Katchal Island of Nicobar district. The palms of Katchal Tall are morphologically similar to Andaman Ordinary Tall but with differences in nut characteristics. An accession collected and evaluated at WCGC has shown that the palms of this cultivar

are robust, high yielding with higher copra content. The kernel is thick and recorded higher milk recovery under VCO production process. The fruits are green, large to exceptionally large sized, husk thickness is thin (2.5 cm), husked fruits are oblong, good tender nut water quantity (706 ml per fruit), average fruit weight over 1814.25g with average copra content of about 217.75g. The oil content is about 64%. Under the natural habitat of rainfed conditions of Katchal, the palms exhibited large bole, stout stem, good fruit setting with estimated fruit yield of over 140 nuts per palm per year, regular production of bunches and dense crown. The fruit colour in the population is predominantly green but considerable proportion of palms produce reddish brown fruits which are preferred for tender coconut purpose. The copra quality is considered incredibly good, and the tender coconuts are categorized as particularly good for water taste and tender kernel taste.

Tamaloo Tall (Acc 26)

It is a cultivar of Tamaloo village of Car Nicobar Island in Nicobar district, preferred for copra production and culinary uses. An accession collected from this population and evaluated at WCGC has shown that the palms of this cultivar are robust, high yielding with higher copra content. The kernel is thick and recorded higher milk recovery under VCO production process. The fruits are green-yellow, husk thickness is thin (2 .47cm), husked fruits are oblong, good tender nut water quantity

(459 ml per fruit), average fruit weight over 1809g with average copra content of about 246g. The oil content is about 66%. Under the natural habitat of rainfed conditions in Car Nicobar, the palms exhibited large bole, stout stem, good fruit setting with estimated fruit yield of over 120 nuts per palm per year, regular production of bunches and dense crown. There are no major pests recorded in this population. Careful mother palm selection followed by seedling selection is important to establish good plantation of Tamaloo Tall considering the variability observed in the natural and conserved population.

Campbell Bay Tall (Acc 30)

It is a cultivar of Great Nicobar Island in Nicobar district preferred for copra production. An accession collected and evaluated at WCGC has shown that the palms of this cultivar are robust, high yielding with higher copra content. The kernel is thick (1.4 cm) and recorded higher milk recovery under VCO production process. The fruits are green-red, thin husk(2 .06cm), husked fruits are oblong,

good tender nut water quantity (365 ml per fruit), average fruit weight over 1369.50g with average copra content of about 183g. The oil content is about 64.5%. Under the natural habitat of rainfed conditions in Great Nicobar, the palms exhibited large bole, stout stem, good fruit setting with estimated fruit yield of over 150 nuts per palm per year, regular production of bunches and dense crown. The population produce good proportion of palms with micro sized fruits and exceptionally large sized fruits. Hence, mother palm selection and seedling selection must be followed stringently.

Conclusion

The popular and promising tall cultivars of these Islands have immense potential as they perform well under marginal management conditions. Careful selection from these types could be especially useful in developing climate resilient coconut varieties aspiring for drought tolerance, wind tolerance and high yield. Apart from the above popular cultivars, many, diverse tall type accessions have been collected from these tropical Islands of Andaman and Nicobar which has been well reported to be exceptional and unique. More than 100 diverse accessions with varying morphological characteristics have been collected from different parts of these Islands and conserved at National Coconut Gene Bank of National Active Coconut Germplasm Site maintained by ICAR-CPCRI. The unique germplasm resources of Andaman and Nicobar Islands include fruits having soft endosperm, fruits with horn like structures, fruits with aroma, cluster bearing micro coconut types, spicata type, beaked fruit types, pink husked types, thin husked fruit types, sweet/soft husked types, persistent leaf base type, persistent inflorescence type, wind tolerant types having very sturdy stem, compact crown types, viviparous coconuts, and high yielding accessions. Wide variation also has been reported for morphological and fruit component traits among all these diverse types. The coconut groves in Nicobar district could be considered as a in situ coconut gene bank wherein one can see and select all the diverse types. ■

Refractive Index: A simple physical parameter for quality analysis of coconut oil

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Introduction

Coconut palm is generally known as Kalpavriksha and is known by different names in different regions like Tree of life" or "Tree of heaven" or "Tree of abundance". These names indicate its diverse and multiple uses and importance in lifestyle of individuals within the tropics. Each and every part of the palm is valuable and has multiple uses in agriculture, in health and religious fields. In South India and Southeast Asia, coconut oil is obtained mainly by processing of copra and is widely used for cooking. It occupies a major position as culinary fat in Kerala. Apart from its food value, it has medicinal and cosmetic value as it is rich in health factors (Ahuja et al., 2014).

Coconut oil belongs to a specific group of oils known as lauric oils. The major fatty acid present in the coconut oil is lauric acid (C12:0) and it accounts for 45 per cent of the total fatty acid composition. The health properties of coconut oil are contributed by the lauric acid. Moreover, palm kernel oil is also included in the category of lauric oil (Dayrit, 2014). The adulteration of fats and oils is not easy to detect when the adulterant has a composition near to that of the original oil. Palm kernel oil among oils is closest to coconut oil in terms of fatty acid saturation level. It blends easily with coconut oil and price is nearly 60 per cent of that of coconut oil thus making mixing perfect and the process profitable. But coconut oil adulterated with mineral oil is bad for health. Hence the quality of coconut oil was analyzed with the help of refractive index.

Materials and Methods

Sample Collection

Pure coconut oil was obtained from the coconut expeller and five different brands of coconut oil samples from different shops were collected and analyzed separately. Pure coconut oil obtained from the expeller was mixed separately with 1, 5, 10, 15, 20 and 30 per cent of palm kernel oil and mineral oil. The treatments of the experiment were twenty.

Determination of Refractive Index

Refractive Index of the oil at 40°C was determined by using a Butyro-refractometer (ATAGO RX – 50001) (Fig 1). Two drops of sample was placed on the lower prism. Prisms were closed and mirror was adjusted to get the sharpest reading. Refractive index is greatly affected by temperature, and hence care was taken to keep temperature constant. Temperature correction was undertaken automatically in the instrument itself. The reading of Butyro refractometer was converted to refractive index with the help of the table of FSSAI (FSSAI, 2015).

Results and Discussion

Adulteration and purity of oil can be checked by the refractive index. Pearson (1981) observed that refractometer could be used to determine the refractive index of oil and the value obtained for each oil would be unique.

The effect of refractive index on the quality assessment of oil samples is presented in Table 1.

Fig 1. Refractometer

According to FSSAI (2015), refractive index is defined as the ratio of velocity of light in vacuum to the velocity of light in the oil or fat or it is described as the ratio between the sine of angle of incidence to the sine of angle of refraction. Refractive index of the samples can be measured by using a suitable refractometer. FSSAI standard for refractive index of coconut oil at 40°C is 1.4481-1.4491.

Atasie and Akinhanmi (2009) studied the physico chemical characteristics of palm kernel oil and the refractive index obtained was 1.453. Ariponnammal (2012) reported that percentage of adulteration in coconut oil was about thirty percent of palm oil and it could be detected using Abbe's refractometer of good accuracy. In a study conducted by Srivastava et al. (2016), it was found that the refractive index of copra oil, hot extracted virgin coconut oil and cold extracted virgin coconut oil were 1.4480. Bahadi et al. (2019) studied the physico chemical properties of Malaysian crude palm kernel oil (CPKO) and reported that the refractive index of crude palm kernel oil at 28°C was 1.455. According to FSSAI (2015), refractive index for palm kernel oil is 1.4490-1.4520.

The refractive index of samples T1 to T13 which included pure coconut sample collected from expeller, branded coconut oil, coconut oil mixed with 1, 5, 10, 15, 20 as well as 30 per cent palm kernel oil and 1 per cent mineral oil was 1.449. The highest refractive index was noticed for treatment T20 (mineral oil) and the value obtained was 1.467. This was followed by T18 (coconut oil mixed with 20 per cent mineral oil) which showed a refractive index of 1.453. The refractive index started changing

Table 1. Refractive Index at 40°C of oil samples

Treatments	Refractive Index at 40°C
T1 (Pure sample)	1.449
T2 (Branded sample 1)	1.449
T3 (Branded sample 2)	1.449
T4 (Branded sample 3)	1.449
T5 (Branded sample 4)	1.449
T6 (Branded sample 5)	1.449
T7 1% PKO+ 99 % Coconut oil	1.449
T8 5% PKO + 95 % Coconut oil	1.449
T9 10% PKO+ 90% Coconut oil	1.449
T10 15% PKO+ 85 % Coconut oil	1.449
T11 20% PKO + 80% Coconut oil	1.449
T12 30% PKO+ 70% Coconut oil	1.449
T13 1% Mineral oil + 99% Coconut oil	1.449
T14 5% Mineral oil + 95 % Coconut oil	1.450
T15 10% Mineral oil+ 90% Coconut oil	1.451
T16 15% Mineral oil+85% Coconut oil	1.451
T17 20% Mineral oil+ 80% Coconut oil	1.452
T18 30% Mineral oil+ 70% Coconut oil	1.453
T19 PKO	1.450
T20 Mineral Oil	1.467
SE(m) ±	0.00000068
CD (0.05)	0.0001

from coconut oil mixed with 5 per cent mineral oil onwards. Refractive index started increasing when more quantity of mineral oil substituted the coconut oil. In the analysis, treatment T19 (palm kernel oil) obtained a refractive index (1.450) which was above the value of pure coconut oil.

In the experiment all the branded coconut oil samples showed a refractive index within the standard value. When palm kernel oil was used as an adulterant in different concentrations below 30 percent, the values obtained were within the FSSAI standard for coconut oil and it was difficult to detect the adulterant. When mineral oil was used as an adulterant, adulteration could be detected from the addition of 5 per cent of mineral oil.

Conclusion

All branded coconut oil samples and coconut oil mixed with different concentrations of palm kernel oil obtained a value within the FSSAI standard while mineral oil adulterated samples exceeded the FSSAI limit. High refractive index (1.4674) was noticed for mineral oil. Hence mineral oil adulterated samples was easily identified with the help of refractive index. ■

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Recent Exotic Invasive Whiteflies Succession in Coconut

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Coconut Cocos nucifera L. (Arecaceae) is an important plantation crop and millions of people depend on this directly or indirectly for their livelihood. India is one of the leaders in coconut farming and stands third largest coconut producing country in the world. In India, coconut is cultivated in 2.17 million ha with production of 20,308 million nuts with an average productivity of 9,345 nuts/ha during 2019-2020. Among all the coconut producing states, Tamil Nadu, Kerala, Karnataka and Andhra Pradesh are the leading coconut producing states which account for more than 90% of the total coconut produced in the country.

The coconut palm is attacked by several insect and mite pests all around the year from the seedling stage to matured palm. Among them, Eriophid mite, Aceria guerreronis Keifer, rhinoceros beetle, Oryctes rhinoceros L, red palm weevil, Rhynchophorus ferrugineus Olivier, black headed caterpillar, Opisina arenosella Walker and white-grub, Leucopholis coneophora Burmeister are considered as the major pests of coconut. While the two whiteflies viz., areca nut whitefly, Aleurocanthus arecae David and Manjunatha and invasive spiralling whitefly, Aleurodicus dispersus Russell recorded on coconut in India are considered as minor pests (Josephrajkumar et al., 2012) (Fig.1). Since 2016, coconut ecosystem is facing continuous succession of several invasive whiteflies causing great threat to its production and productivity.

Between 2015-2019, the following four exotic, highly polyphagous whiteflies viz., rugose spiralling whitefly, Aleurodicus rugioperculatus Martin during 2016 (Sundararaj and Selvaraj, 2017); Bondar's nesting whitefly, Paraleyrodes bondari Peracchi during 2018 (Josephrajkumar et al., 2019); nesting whitefly, P. minei Iaccarino during 2018 (Mohan et al., 2019) and palm infesting whitefly, Aleurotrachelus atratus Hempel during 2019 (Selvaraj et al., 2019) invaded rapid succession on coconut. These invasive species are native to the Neotropical region, mostly from Central America and the Caribbean.

The most insidious spread of these species in India is likely mediated by humans through the movement of infested seedlings and planting materials. Extensive surveys revealed that these species spread rapidly in the large geographical region of India mostly through transportation of infested seedlings. Extensive spread along the coastal regions and gardens near the backwater of India is predicted owing to the favorable weather factors and availability of host plants. Species of exotic whiteflies with similar habits co-exist in more or less the same niche and have a similar pattern of growth and development.

Systematic and continuous surveys were conducted from January 2016 to December, 2021 in different states viz., Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Maharastra, West Bengal, Goa, Maharastra, Telangana, Meghalaya, Gujarat and Lakshadweep islands of India to investigate the spatial range, host range, patterns of co-occurrence, intensity of infestation of whiteflies and their natural enemies in India. To study the distribution of these invasives at least 5-10 locations in each district and 5-12 districts in each state were chosen for sampling. Pest occurrence was recorded in each location and

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Fig. 1. Infestation of Aleurodicus dipsersus and Aleurocanthus arecae on coconut

their damage was categorized into different grades by visual observation on all the active /live life stages.

An assessment of their population level was carried out using the following qualitative scale i.e Low (=less than 10 live egg spirals or adults/leaflet), moderate = (11-20 live egg spirals or adults/leaflet) and severe= (more than 20 live egg spirals or adults/ leaflet). The coexistence of these invasive whiteflies with other insect species at each location was also determined. Part of infested with immature stages and puparium were placed in rearing jar (21×10 cm) for the emergence of parasitoids. The diagnositic characteristics, distribution, symptoms of damage, co-occurrence, associated natural enemies and management strategies with special reference to biological control are briefed in details.

1. Spiralling whitefly, *Aleurodicus dispersus Russell*

Distribution: Spiralling whitefly, Aleurodicus dispersus is the first invasive whitefly to India which is native to the Caribbean islands in Central America and the species was first found on coconut in Florida. In India, it was first reported in 1993 in Kerala and later, it was reported in Tamil Nadu, Karnataka, Maharashtra, Lakshadweep, Orissa and North East Region in India. Presently this pest is almost distributed throughout the country on many horticultural, plantation and avenue plantation.

Host plants: Aleurodicus dispersus is highly polyphagous affecting on a wide range of host plants and is known to feed on 320 plant species belonging to 225 genera and 73 families. In coconut, the pest occurs in sporatically and its infestation mostly negligible to low reported.

Diagnostic charateristics: Presence of spiralling mealy wax, white waxy flocculen materials and darken sooty mould on infested plants. Nymphs and adults are congregate generally on the lower surface of leaves and secrete copious white, waxy flocculent materials which are readily spread elsewhere by wind and create a very unsightly nuisance (Fig.2). By sucking the sap which depletes nutrients and water from host plants and causes premature drying under severe infestation. Sticky honeydew is excreted which serves as a substrate for dense growth of sooty mould which may interfere with photosynthesis. Female whitefly lays elliptical, smooth surfaced yellowish white eggs in a typical spiral pattern. There are four nymphal instars, which are greenish, white and oval which are covered with heavy white wax material. Adults are larger coated with a fine dust like waxy secretion and fore wings with characteristic dark spots and live for 13 to 22 days (Fig.2).

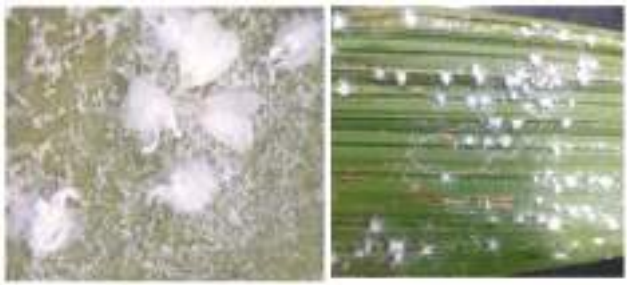

Fig.2. Life stages of Aleurodicus dispersus and its infestation on coocnut

2. Rugose spiralling whitefly, *Aleurodicus rugioperculatus Martin*

Distribution: Rugose spiralling whitefly was described from coconut in Belize and believed to have originated from Central America. In India, its incidence was recorded on coconut during 2016 at Pollachi, Tamil Nadu. Subsequently it has spread to different districts of Karnataka, Kerala, Andhra Pradesh, Goa, Assam and West Bengal, Lakshadweep islands, Maharashtra, Gujarat, Telangana, Odisha, Chhattisgarh, and few districts of Meghalaya (Fig.3).

Host plants: Rugose spiralling whitefly is a highly polyphagous pest reported to feeds on about 120 plant species including economically important cultivated crops and palms. In India, Rugose spiralling whitefly was found to feed on about 45 host plants. Pest prepares to feed on plants under Arecaceae family. Pest incidence was severe in dwarf as well as hybrid coconut palms. Infestation of rugose spiralling

Fig.4. Diagnostic characters of rugose spiralling whitefly

whitefly reaches to outbreak situation especially during summer months if necessary management strategies are not initiated on time.

Diagnostic charatceristics: The typical concentric waxy spiraling symptoms are noticed on various parts of host plants including on leaf petiole and tender nuts. Nymphs and adults suck the sap from the leaves by direct feeding especially on the underside of the leaflets. Adults excrete the prodigious quantities of honey dew which in turn completely is darkened by the development of sooty mold on the upper surface of leaves and also on understory crops (Fig.4). Waxy flocculent material produced by nymphs and adults causes' nuisance to human being in heavily infested areas.

Adults are about three times larger than the commonly found whiteflies and are lethargic by nature. Adults can be distinguished by the presence of a pair of irregular light brown bands across the wings. Males have long pincer-like structures at the distal end of the abdomen. This whitefly is closely related to the giant whitefly, Aleurodicus dugesii Cockerell.

3. Bondar's nesting whitefly, *Paraleyrodes bondari Peracchi*

Distribution: Paraleyrodes bondari described on citrus from Brazil in 1971 and this species is native to the Neotropical region. It was first reported in India on coconut palms in Kerala during 2018 (Josephrajkumar et al., 2019), Karnataka and The Andaman & Nicobar Islands, Lakshadweep islands, Tamil Nadu and Andhra Pradesh.

Host plants: Paraleyrodes bondari is a polyphagous species that has been reported to feed on more than 25 host plants including coconut.

Fig. 5. Diagnostic characters of Paraleyrodes bondari

Diagnostic charatceristics: Paraleyrodes bondari adult are smaller than Aleurodicus rugioperculatus and it constructs nests with loosely woven, irregular layer of fiberglass-like woolly wax strands. Adults lay yellowish stalked eggs in clusters in the woolly wax nest without wax covering. Early instar nymphs are creamy yellow, transparent, oval shaped and absolutely flat. Excessive de-sapping by the adults and nymphs in severe condition produces honey dew leading to deposits of sooty mould on plant surface which may affect the photosynthetic efficiency.

The feeding damage is not so intense like rugose spiralling whitefly with minimal honey dew excretion and sooty mould deposits. Adult whiteflies are with in dull yellow body with whitefly wings. Two oblique grey bands occur on each forewing, and converge toward the midline is such that it appears to form an "X"-pattern (Fig.5).

Nesting whitefly, *Paraleyrodes minei laccarino*

Distribution: Paraleyrodes minei laccarino described from Syria on citrus in 1990 is considered a native of the Neotropical region. In India, it was reported on coconut in Kerala during 2018 (Mohan et al., 2019) and in Andaman & Nicobar Islands, Karnataka, Tamil Nadu.

Host plants: Nesting whitefly is highly polyphagous and found to colonize on more than 35 plants including coconut palm.

Diagnostic charatceristics: Paraleyrodes minei nymphs and adults feed from abaxial leaf surface and produce honeydew which in turn leads to sooty mould deposits and interfere with photosynthetic efficiency of the palms. Female adults constructs loosely woven, woolly wax nest and this characteristic feature helps in differentiating nesting whitefly from the Bondars nesting whitefly that constructs

Fig.6. Infestation of nesting whiteflies on coconut

Fig.7. Infestation of Aleurotrachalus atratus on coconut

conspicuous dense woolly wax nest (Fig.6). Eggs are cream-coloured laid in clusters with short stalks that turn slight pinkish upon eclosion on the lower surface of leaflets bending inwards towards the leaf surface.

4. Palm infesting whitefly, Aleurotrachelus atratus Hempel

Distribution: This is a Neotropical whitefly, originally described by Hempel from Brazil and distributed in Africa, North America, South America, Central America, the Caribbean and Europe. In India, this pest was first recorded on coconut and ornamental palms during 2019 in Mandya district of Karnataka (Selvaraj et al., 2019) and subsequently spread to other districts in Karnataka and Tamil Nadu.

Host plants: Palm infesting whitefly colonizes on more than 110 plant species including coconut. In India, so far it was found to feed on coconut, areca nut, oil palm and ornamental areca palm belonging to Arecaceae family.

Diagnostic charatceristics: Aleurotrachalus atratus colonizes on the under surface of leaflets in groups and produce white wax mass from second nymphal instar onwards. Both nymphs and adults suck the sap continuously and deplete nutrients from host plants resulting in necrosis, loss of vigour, drying and drooping of leaflets. Indirect damage is caused by the excreted honeydew that serves as a medium for the growth of sooty mould (Fig.7).

Eggs are stalked and laid in semicircular pattern in groups, initially creamy white and turn to black before hatching. All the nympal instars are black in colour with a long marginal white wax fringe and filaments completely cover the pupae. Adults differ from the other invasive whiteflies infesting palms; smaller than A. rugioperculatus but larger than P. bondari and P. minei and without any wavy marking on the wings.

Co-existence of whiteflies in coconut: Aleurodicus rugioperculatus co-existing with Aleurotrachalus atratus, P. bondari, A. dispersus and P. minei were observed to simultaneous coexistence on coconut. Infestations of A. atratus and A. rugioperculatus along with Aleurocanthus arecae, a native whitefly species were commonly observed on coconut (Fig.8). Such co-occurrence has been observed among these invasive species, in which one species occupies the breeding and feeding niche of another species under optimum weather parameters and attempts to displace one or more of its competitors gradually which leads to temporal variation.

Natural enemies of the invasive whiteflies: Explorative surveys revealed the occurrence of several biological control agents to develop the biocontrol strategies for management of these invasive whiteflies. Two parasitoids, Encarsia guadeloupae Viggiani and E. dispersa Polaszek (Hymenoptera: Aphelinidae) were found to colonize A. dispersus and A. rugioperculatus (Fig.9). Among, Encarsia guadeloupae was the dominant parasitoid which parasitized 62-95% and 56-82% of A. dispersus and A. rugioperculatus, respectively whereas E. dispersa parasitized 28-92% and 5-10% of A. dispersus and A. rugioperculatus, respectively. Predators such as Pseudomallada astur (Neuroptera: Chrysopidae), Jauravia pallidula, Cheilomenes sexmaculata (Coleoptera: Coccinellidae) and Cybocephalus indicus (Coleoptera: Nitidulidae) were also observed to be feeding on A. rugioperculatus, A. atratus and A. dispersus (Fig.9). In addition, entomopathogenic fungi, Isaria fumosorosea (Hypocreales: Clavicipitaceae) was found to be effective against A. rugioperculatus, P. bondari, P. minei and A. atraus. Neither parasitoids nor native predators were recorded for the other invasive whitefly species.

Economic importance of invasive whiteflies in coconut: Invasive whiteflies pose a challenge to the Indian economy as biologists and the public world-wide increasingly recognize the damage caused by invasive non-indigenous species. Non-native species can achieve major pest status when they

Fig.8. Co-existence/co-occuring of whiteflies in coconut

Fig. 9. Natural enemies associated with invasive whiteflies infesting coconut

are accidentally introduced to new locations and are separated from their natural enemy complexes. Coconut is an important crop grown mainly in the tropical and subtropical regions of the world. Host preference of these invasive whiteflies towards coconut in the country of their origin leads to quicker establishment on these host plants in the newly introduced regions. Out of the eight invasive species new to India, A. dispersus, A. rugioperculatus, A. floccosus, P. bondari and P. minei were found to infest coconut.

The global invasive species program proposes three major management options: prevention, early detection, and eradication for the management of alien species. Prevention of an invasion is the most economical option as it contains pest to spread to neo geographical regions. Post incursion management mostly through timely implementation of classical biocontrol programme using potential natural enemies by importation. Fortunately, most of such invasions, especially those of hemipteran species of the suborder Sternorrhyncha, which includes whiteflies, scale insects, aphids are amenable for classical biological control. Effective biological control programme has been implemented for A. rugioperculatus and A. dispersus resulting in saving millions of rupees by mitigating their adverse impacts on agriculture.

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Obituary

Dr. M Aravindakshan, former Chairman of Coconut Development Board expired on 27th December 2021. He was the Chairman of the Board for two years from September 1995. As the Chairman of the Board, he was instrumental in the implementation of various coconut development programmes during the 8th Plan period and has –played a significant role in formulating schemes of the Board for the 9th Plan period. Prior to his appointment as Chairman, CDB he was employed with Kerala Agriculture University in various posts for 28 years. Dr. M Aravindakshan did his post doctoral training in the University of Hawai, USA during 1995. He was the visiting professor of the University of Paraiba, Brazil during 1979-80. Dr. M. Aravindakshan had over 40 years of experience in teaching, research and extension activities in tropical horticulture.

Technology inventory of AICRP on Palms - Coconut

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Director of Research, University of Horticultural Sciences, Bagalkote

Introduction

The All India Coordinated Research Project on Palms of Indian Council of Agricultural Research (ICAR) under National Agricultural Research System (NARS) started functioning from 1972 is a unique mechanism for testing location-specific and need-based innovations in different agro-climatic conditions of the country. Under this system, both the ICAR and State Agricultural Universities (SAUs) work as partners with 75% and 25% budget sharing, respectively in an interdisciplinary approach. The Project provides a platform and opportunities to the scientists for exchanging ideas and materials for working on similar problems in different agro-ecological regions for collectively developing solutions. They work together in crop improvement, effective production and plant protection and disseminating the technology in the region towards stability and profitability of the mandate crops viz., coconut, oil palm, arecanut, palmyrah and cocoa and it is implemented in 28 centres, which are located in 14 states and one union territory covering 13 SAUs/SHUs, one CAU and four ICAR institutes. The AICRP on Palms contributes to the development of horticulture in the country through testing and release of the varieties and technologies besides the supply of quality planting materials. This, in turn, has contributed to an increase in the area under new varieties and technologies of plantation crops in several states.

Crop improvement

Evaluation of coconut germplasm and hybrids for their performance in different agro-climatic regions is one of the priority areas of research under AICRP on Palms. The germplasm maintained at different centres are used for location specific breeding programmes. Based on the comparative performance in evaluation trials, 20 high yielding varieties/hybrids have been released since its inception. The features of the recent varieties/hybrids which are notified by CVRC are presented in table 1.

Establishment of Nucleus seed gardens for released varieties in coconut

The success of coconut plantation establishment starts with the production of good quality planting materials. Selecting the best planting materials before field planting assures higher productivity. Planting coconut seed nuts directly in the field is not recommended and care must be taken in choosing the seedlings to start a plantation since high quality planting materials provide a good head start to sustain the coconut palms productive and economic lifespan of 60 or more years. Nucleus seed gardens with released varieties of coconut have been established for producing quality planting materials in AICRP Palms centres and supplied 9.67 lakhs of coconut seedlings of released varieties and hybrids to coconut farmers and this, in turn, has significantly contributed to the expansion of area under coconut with better production potential.

Sl. No	AICRP centre	Coconut Varieties
1	Aliyarnagar	Kalpa Pratibha, Kera Keralam
2	Arsikere	Kalpatharu, Gauthami Ganga
3	Ambajipeta	Gauthami Ganga, Kalpa Pratibha, Kera Bastar
4	Jagdalpur	Kera Bastar
5	Kahikuchi	Malayan Yellow Dwarf
6	Mondouri	Kalyani Coconut 1, Kalpa Mitra, Kera Keralam
7	Ratnagiri	Gauthami Ganga, East Coast Tall, Kera Bastar
8	Veppankulam	Kera Keralam, Kalpa Pratibha
9	Port Blair	CARI Annapurna, CARI Omkar, CARI Surya, CARI Chandan

Crop Production

• **Fertigation:** Application of 50% of recommended dose of NPK through fertigation in 10 monthly splits was found to be sufficient for higher yield of coconut in Kerala, Tamil Nadu and West Bengal. Similarly, 75%

Table 1. Varieties/hybrids released from AICRP on palms through selection and hybridization from germplasms

Variety/ Hybrid and year of release	Breeding method and Parents	Important traits	Recommended state
Kalpatharu (2009)	Selection from Tiptur Tall	Suitable for ball copra production. The average yield of 20300 nuts/ ha, copra yield of 35 q/ha and oil yield of 25 q/h.	Rain fed and irrigated regions of Karnataka, Tamil Nadu an d Kerala states.
Kalpa Samrudhi (2009)	Hybrid (MYD x WCT)	High yielder (104 nuts/palm/year) with higher copra out turn (3.1 t/ha) and oil content (68.0%) The hybrid is semi-tall, precocious bearing (comes to bear at 5 years)	Kerala and Assam
Kalpa Jyothi (2012)	Selection from IND 058(MYD)	Dwarf variety with yellow fruits, higher average yield of 114 nuts per palm per year under rainfed conditions with estimated copra yield of over 16 kg per palm per year.	Kerala, Karnataka and Assam
Kalpa Surya (2012)	Selection from IND 048(MOD)	Dwarf with Orange fruits for tender nut purpose. The average yield is 123 nuts per palm per year under irrigated conditions with estimated copra out turn of 23 kg per palm per year.	Kerala, Karnataka and Tamil Nadu
Kalpa Sreshta (2014)	Hybrid (MYD x TPT^{-})	The mean yield is 167 nuts/palm/year, with estimated high copra out turn of 35.9 kg/ palm/year or 6.28t/ha copra. The hybrid is suitable for tender nut purpose; ball copra purpose also.	Kerala and Karnataka
Vasista Ganga (2014)	Hybrid (GBGD x PHOT)	Found promising based on its precocity, higher nut yield (125 nuts/palm/year), copra output (21.9 kg/palm/year), oil content (69% and oil yield 15.1 kg/palm/year) with good tender nut water content (395 ml) and TSS (6.20Brix).	Andhra Pradesh
Abhaya Ganga (2014)	Hybrid (GBGD x LCOT)	High yielding, precocious; having heavy bunches with average nut yield (128 nuts/ palm/year), copra output 21.7 kg/palm/year, oil content 72 % and oil yield 15.5 g/palm/ year).	Andhra Pradesh
Kalpa Ganga (2014)	Hybrid (GBGD x FJT)	Nut yield of 120 nuts/ palm/year. Copra out turn of 3386 kg /ha. Short stature and suitable for ball copra production.	Karnataka
VPM 4 (2015)	Hybrid (LCT x CCNT)	The mean nut yield of the hybrid during the stabilized bearing period was 161 nuts/palm/ year, with copra content of 149.8 gm/ nut and oil content of 70.0 % with higher quantity of tender nut water (368 ml /nut) of good quality (4.8 °brix TSS).	Tamil Nadu
Kalpa Shatabdi (2016)	Selection from San Ramon	It records an average yield of 105 nuts / palm / year and has large nuts with a copra content of 272.9g/nut with an estimated copra yield of 28.65 kg/palm.	Tamil Nadu, Karnataka and Kerala
Kalpa Ratna (2018)	Selection from Federated Malay States (IND 010 S)	A tall coconut variety selected from Federated Malay States (IND 010 S) with copra content of 162 g/ nut and a copra yield of 12.7 kg/ palm/ year.	Karnataka, Kerala and Tamil Nadu


Kalpatharu


Kalpa Samrudhi


Kalpa Jyothi


Kalpa Surya


Kalpa Sreshta


Vasista Ganga


Abhaya Ganga


Kalpa Ganga


VPM 4


Kalpa Shatabdi


Kalpa Ratna

of dose of NPK through fertigation in 10 monthly splits was found to be sufficient in Andhra Pradesh and Karnataka.

• **HDMSCS:** Coconut Based High Density Multi Species Cropping System involving crops like Black Pepper, Cocoa, Banana, Drumstick, Nutmeg, Cinnamon, Pineapple, Turmeric, Elephant Foot Yam, Tapioca, Bhendi and Coriander were recommended with suitable combinations for different regions, which enhanced the net income to the tune of Rs. 1.75 lakhs to Rs. 3.25 lakhs/ha as compared to coconut monocrop (Rs. 70,000 to Rs. 90,000/ha).

• **Intercropping with medicinal and aromatic crops:** Crops such as Galangal, Lemon grass, Patchouli, Pipali, Citronella, Aloevera, Tulsi, Palmarosa, Sarpagandha, Aswagandha, Arrow root, Amahaldi, Sathavari, Garden rue, Mango ginger, Makoi and Kalmegh were recommended for cultivation in coconut garden in different regions - resulted in an additional net income to the tune of Rs. 1.20 lakhs to Rs.1.75 lakhs/ha.

• **Intercropping of flower crops in coconut garden:** Suitable flower crops identified to be grown under coconut are Marigold, Gomphrena, Celosia, Zinnia and Chrysanthemum at Aliyarnagar (Tamil Nadu), Chrysanthemum, Crossandra, China aster and Marigold at Arsikere (Karnataka), Gerbera, Tuberose, Gladiolus and Marigold at Kahikuchi (Assam) and Gladiolus, Tuberose and Gerbera at Mondouri (West Bengal) and Lily, Heliconia and Jasmine at Ratnagiri (Maharashtra) - enhanced the net income to the tune of Rs. 2.00 lakhs to Rs. 4.00 lakhs/ha.

• **Integrated Nutrient management under coconut based cropping system:** Application of 50% of RDF (NPK) + 50% N through organic recycling with vermicompost + vermiwash + biofertilizer and in situ green manuring recorded higher system productivity followed by 75% of recommended NPK + 25% through organic recycling with vermicompost or fully organic - recommended from Aliyarnagar, Ambajipeta, Arsikere, Bhubaneswar, Jagdalpur, Kahikuchi, Mondouri, Navsari, Ratnagiri, Sabour and Veppankulam centres for adoption by farmers.

Coconut based cropping systems

Intercropping of flower crops in coconut garden

Disease Management

▶ *Leaf blight*

• Molecular characterization of Lasiodiplodia theobromae isolates was carried out at Aliyarnagar Centre. Through PCR amplification of ITS region of L. theobromae isolates, an expected amplicon of 550 bp was obtained and the sequences were deposited in Gen Bank (Accession numbers; MG685854, MG685855and MG 697234).

• At Aliyarnagar Centre, in the field evaluation trial, sequential root feeding of carbendazim @ 5 g/ 100 ml of water during January and July followed by propiconazole @ 5 ml/ 100 ml of water during April and October was found to be effective in controlling the disease.

▶ *Stem bleeding*

• The new fungicide molecules with combi product (carbendazim 25% + Mancozeb 50% WS) was tested against mycelial growth of Thielaviopsis paradoxa under in vitro conditions. Cent percent inhibition of pathogen at lower concentration i.e. 100 ppm indicated its strong action against the test pathogen. Application of neem cake based formulation of "Trichoderma harzianum" cakes (one cake /bleeding patch/year) was found effective for the management of stem bleeding disease in coconut in Andhra Pradesh.

▶ *Bud rot*

• Talc based formulation of Trichoderma reesei @ 5 g/coconut seedling at spindle region is recommended for application during pre monsoon period in Andhra Pradesh State.

▶ *Basal stem rot*

• Soil application of talc based formulation @ 125g each of Trichoderma reesei and Pseudomonas fluorescens+ 5 kg of neem cake per palm at yearly interval have been recommended for the management of basal stem rot disease in coconut.

Insect-Pest Management

▶ *Management of rhinoceros beetle*

Application of CPCRI Botanical cake @15 g/ palm + paste@ 15g /palm is recommended against rhinoceros beetle in juvenile palms as it was found effective in reducing spindle damage and leaf damage in coconut.

▶ *Management of Eriophyid mite*

Effective INM and IPM package involving (i) application of recommended dose of fertilizers with 20 kg vermicompost and 5 kg neem cake/palm (ii) growing of green manure crops viz., cowpea / sunnhemp in the inter rows and ploughing in situ at flowering stage (iii) application of Keraprobio (100 g/palm) (iv) root feeding with fenpyroximate 5% EC @ 10 ml (in the month of March) and (v) spraying of palm oil-sulphur emulsion (during December) are effective packages for reducing infestation of eriophyid mite in coconut.

▶ *Management of Rugose Spiraling Whitefly*

Installation of Yellow Sticky Traps in coconut garden is recommended for effective attraction of RSW in coconut in order to mitigate their incidence.

• Black headed caterpillar: Black headed caterpillar management in coconut was carried out by production and release of parasitoids like Goniozus nephantidis (4,20,000 nos.), Bracon sp.(4,30,100 nos.) in farmers' fields of different regions.

▶ *Release of parasitoid by a farmer*

Integrated management of Slug Caterpillar: The

IPM packages comprising mechanical removal and destruction of larval and pupal stages, installation of light traps @ 5 nos./ha, application of recommended dose of fertilizers, spraying of insecticide chlorantraniliprole 18.5 % SC @ 0.3 ml/litre and release of potential parasitoid Pediobius imbreus @ 60/palm is recommended for effectively managing the incidence of slug caterpillar in coconut. ■

COCONUT MILK MURUKK

Coconut Recipe

Ingredients

Rice Flour: 2 cups
Coconut Milk: 1 cup
Urad dal flour: ½ cup
Asafoetida powder: 2 pinches
Seasame seeds : 2 tsp
Butter : 1½ tsp
Oil: as required for frying
Salt: to taste

Method : Take a bowl and add rice flour, asafoetida powder, urad dal powder, sesame seeds and salt. Add butter and mix well. Pour coconut milk little by little and mix and make a soft dough.

Heat oil in a pan. Take the murukk dough in the murukku maker (Sevanazhi) in which the disc with one hole is put. Now press it to the hot oil in circular motion in the shape of murukku. When both sides become golden brown transfer them to a strainer. After a while, place them in a paper towel to avoid extra oil in it. Transfer to a washed and sun dried bottle. These murukks are easy to bite since it is prepared with coconut milk and is crispy.

Prepared by: Indu Narayanan

The potential of
Coconut Oil and its derivatives as effective and safe antiviral agents against the Novel Coronavirus (ncov-2019)

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As we write this, the World Health Organization has declared a global emergency over the novel coronavirus, nCoV-2019, that has spread beyond China. There is still no cure for nCoV-2019. nCoV2019 has been shown to be related to SARS (Zhou et al., 2020), a coronavirus which caused an outbreak in 2003. Several researchers have been designing drugs to specifically target protease enzymes in coronavirus, but testing for these drugs is many months away. What if there is a treatment candidate against the coronavirus that might already be available and whose safety is already established? Lauric acid (C12) and monolaurin, its derivative, have been known for many years to have significant antiviral activity. Lauric acid is a medium-chain fatty acid which makes up about 50% of coconut oil; monolaurin is a metabolite that is naturally produced by the body's own enzymes upon ingestion of coconut oil and is also available in pure form as a supplement. Sodium lauryl sulfate, a common surfactant that is made from lauric acid, has been shown to have potent antiviral properties. Lauric acid, monolaurin, and sodium lauryl sulfate (which is also known as sodium dodecyl sulfate) are used in a wide range of products for their antiviral properties.

Mechanisms of action

Three mechanisms have been proposed to explain the antiviral activity of lauric acid and monolaurin: first, they cause disintegration of the virus envelope; second, they can inhibit late maturation stage in the virus replicative cycle; and third, they can prevent the binding of viral proteins to the host cell membrane.

Disintegration of the virus membrane

The antiviral activities of lauric acid and monolaurin were first noted by Sands and co-workers (1979) and later by Hierholzer & Kabara (1982). In particular, Hierholzer & Kabara showed

that monolaurin was able to reduce infectivity of 14 human RNA and DNA enveloped viruses in cell culture by >99.9%, and that monolaurin acted by disintegrating the virus envelope. Thormar and co-workers (1987) confirmed the ability of lauric acid and monolaurin to inactivate viruses by disintegration of the cell membrane. Sodium lauryl sulfate has been shown to be able to solubilize and denature the viral envelope (Piret 2000, 2002).

Inhibits virus maturation

The Junin virus (JUNV) is the causative agent of Argentine hemorrhagic fever. In a comparison among the saturated fatty acids from C10 to C18 against JUNV infection, Bartolotta and co-workers (2001) showed that lauric acid was the most active inhibitor. From mechanistic studies, it was concluded that lauric acid inhibited a late 2 maturation stage in the replicative cycle of JUNV. From transmission electron microscope images, JUNV is an enveloped virus featuring glycoproteins that are embedded in the lipid bilayer forming viral spikes (*Grant et al., 2012*); this is similar to nCoV2019.

Prevents binding of viral proteins to the host cell membrane

Hornung and co-workers (1994) showed that in the presence of lauric acid, the production of infectious vesicular stomatitis virus was inhibited in a dose-dependent and reversible manner: after removal of lauric acid, the antiviral effect disappeared. They observed that lauric acid did not influence viral membrane (M) protein synthesis, but prevented the binding of viral M proteins to the host cell membrane.

Although lauric acid accounts for much of the reported antiviral activity of coconut oil, capric acid (C10) and monocaprin have also shown promising activity against other viruses, such as HIV-1 (Kristmundsdottir et al., 1999). Capric acid accounts for about 7% of coconut oil. Thus, at least two fatty acids in coconut oil, and their monoglycerides, have antiviral properties. Hilarsson and co-workers (2007) tested virucidal activities of fatty acids, monoglycerides and fatty alcohols against respiratory syncytial virus (RSV) and human parainfluenza virus type 2 (HPIV2) at different concentrations, times and pH levels. They reported that the most active compound tested was monocaprin (C10), which also showed activity against influenza A virus and significant virucidal activities even at a concentration as low as 0.06-0.12%.

Use of coconut oil and C12 derivatives in animals and humans

Coconut oil and its derivatives have been shown to be safe and effective antiviral compounds in both humans and animals. Because of the antiviral and antibacterial protection that it provides to animals, coconut oil, as well as lauric acid and monolaurin,

is used in farm animals and pets as veterinary feed supplements in chicken, swine and dogs (Baltic et al., 2017). Monolaurin has been shown to effectively protect chicken against avian influenza virus (van der Sluis, 2015). Li and coworkers (2009) prepared a gel containing monolaurin and is found to be highly active against repeated high viral loads of Simean immuno deficiency virus in macaques and Kirtane and coworkers (2017) developed a 35% gel of monolaurin for application in the female genital tract to protect against HIV. Sodium lauryl sulfate (SLS) has been used at low concentrations to inactivate viruses in milk of farm animals (de Sousa et al., 2019). SLS is the active constituent in commercial disinfecting wipes and standard laboratory disinfectants, and is an emulsifying agent and penetration enhancer in pharmaceutical preparations. Coconut oil itself has been shown to have anti-HIV properties in small clinical studies. The first clinical trial using coconut oil (45 mL daily) and monolaurin (95% purity, 800 mg daily) against HIV-AIDS was conducted in the Philippines. This study involved 15 HIV patients, aged 22 to 38 years, 5 males and 10 females, for 6 months. There was only one fatality and 11 of the patients showed higher CD4 and CD8 counts after 6 months (Dayrit, 2000). In another study, 40 HIV subjects with CD4+ T lymphocyte counts less than 200 cells/ microliter were divided into a virgin coconut oil (VCO) group (45 mL daily) and control group (no VCO). After 6 weeks, the VCO group showed significantly higher average CD4+ T lymphocyte counts versus control (Widhiarta, 2016).

Conclusion

Several in vitro, animal, and human studies support the potential of coconut oil, lauric acid and its derivatives as effective and safe agents against a virus like nCoV-2019. Mechanistic studies on other viruses show that at least three mechanisms maybe operating. Given the considerable scientific evidence for the antiviral activity of coconut oil, lauric acid and its derivatives and their general safety, and the absence of a cure for nCoV-2019, we urge that clinical studies be conducted among patients who have been infected with nCoV-2019 (see below). This treatment is affordable and virtually risk-free, and the potential benefits are enormous. On the other hand, given the safety and broad availability of virgin coconut oil (VCO), we recommend that VCO be considered as a general prophylactic against viral and microbial infection.

A proposed clinical study

We can propose that a clinical study be conducted o*n patients infected with nCoV-2019 accordingly:*

• Group 1: Control group, standard care

• Group 2: Standard care + VCO (45 mL, approx. 3 three tablespoons, daily or higher,)

• Group 3: Standard care + Monolaurin (95% purity, 800 mg daily). Monolaurin is recognized as GRAS by US FDA.

• Group 4: Standard care + Monocaprin (95% purity, 800 mg daily). Monocaprin is recognized as GRAS by US FDA.

• Group 5: Standard care + SLS (pharmaceutical grade, 100 mg/kg/day). SLS toxicity: lowest NOAEL (repeated dose, rat): 100 mg/kg/day (hepatotoxicity) (Bondi et al., 2015).

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Minimum Support Price (MSP) for Copra for 2022 season announced

The MSP for Fair Average Quality (FAQ) of milling copra has been increased to Rs10,590/- per quintal for 2022 season from Rs.10,335/- per quintal in 2021 and the MSP for ball copra has been increased to Rs.11,000/- per quintal for 2022 season from Rs.10,600/- per quintal in 2021. The revision in the Minimum Support Prices (MSPs) for copra for 2022 season is approved by the Cabinet Committee on Economic Affairs chaired by the Prime Minister Shri Narendra Modi.

The decision is based on the recommendations of the Commission for Agricultural Costs and Prices (CACP). The revised MSP ensures a return of 51.85 percent for milling copra and 57.73 percent for ball copra over the all India weighted average cost of production.

The National Agricultural Cooperative Marketing Federation of India Limited and National Cooperative Consumer Federation of India Limited will continue to act as Central Nodal Agencies to undertake price support operations at the MSP in the coconut growing States.

Shri. K. Narayanan Master elected as Vice Chairman of CDB

Shri. K. Narayanan Master, farmer representative from Kerala who is actively involved in the development of coconut cultivation and allied sectors is the new Vice Chairman of Coconut Development Board. He was serving as a Member of the Board since August 2020. Currently he is the BJP State committee member, and was twice the President of BJP, Malappuram District. He was the Headmaster of AMUP School, Ozhur, Malappuram District. Wife: Smt. Sheeba, Children: Dr. Vivek & Dr. Athira. He will be holding the post of Vice Chairman for one year.

Agrovision

Coconut Development Board, State Centre, Thane participated in 12th edition of Agrovision Exhibition - 2021 from 24–27th December-2021 held at Reshimbag, Nagpur, Maharashtra.

The Agrovision exhibition was inaugurated by Shri Narendra Singh Tomar, Hon'ble Union Minister for Agriculture & Farmers Welfare in the presence of Agrovision Chief Patron, Shri Nitin Gadkari, Hon'ble Union Minister for Road, Transport & Highways, Dr. Ashwath Narayan C N, Hon'ble Minister for Electronics, IT, BT and S&T Higher Education, Skill Development, Entrepreneurship & Livelihood, Government of Karnataka, Shri Sanjay Agarwal IAS, Secretary, Department of Agriculture and Farmers Welfare, Government of India and other dignitaries.

The expo was visited by lakhs of farmers from Maharashtra, Chhattisgarh, Madhya Pradesh, Punjab, Assam, Arunachal Pradesh, Rajasthan and from various other states. Over 350 medium and small enterprises and well-known companies from the agri field displayed their products and services in Agrovision. Grass root level innovators were an added attraction for the visiting farmers.

The participants displayed their research, innovative techniques, products, services etc. The farmers got astounding exposure by witnessing new products, services, technologies and irrigation systems.

Coconut Development Board highlighted Board's activities and ongoing schemes being implemented in the state of Maharashtra. Coconut Development Board displayed various value added coconut products like packed tender coconut water, coconut oil, coconut milk powder, virgin coconut oil, neera sugar, coconut cookies& chocolates, coconut shell powder, shell charcoal etc and informative charts and posters. Board's publications, leaflets and brochures were distributed in the stall.

National Agri – Horti – Expo 2021

Coconut Development Board, Market Development cum Information Centre, New Delhi participated in National Agri, Horti & Food Tech Expo at New Grain Market, Karnal (Haryana) from 17 - 19th December 2021. The Expo was inaugurated by Shri Gurminder Singh Bisla, President of Breeder Broiler Association. North region in the presence of other dignitaries, delegates and senior officials.

Board's stall was arranged with various value added coconut products, coconut handicrafts and attractive posters were displayed in the stall. Publications on coconut cultivation, health benefits of tender coconut, food products made of coconut, shell based industrial products, charcoal etc. were also displayed and distributed to the visitors. Smt. Renu Bala Gupta, Hon'ble Mayor of Karnal visited the expo on 18th December 2021. Around 3000 farmers from Karnal and nearby areas visited the Expo. Organizations like National Horticulture Board, Coir Board, National Research Development Corporation and other private firms from agriculture & poultry industries also participated in the exhibition.

ICAR-CPCRI foundation day celebrated

ICAR-Central Plantation Crops Research Institute (ICAR-CPCRI) celebrated its 106th Foundation Day on 5th January 2022 in online mode. Dr. A.K. Singh, Deputy Director General (DDG)-Horticultural Sciences, Dr. B.K. Pandey, Assistant Director General (ADG)-Horticultural Sciences, former Directors of ICAR-CPCRI, incumbent Directors of other ICAR horticultural institutes, retired CPCRI personnel and other dignitaries who have significantly contributed in the Research and Development of Plantation Crops took part in the programme

Dr.A.K. Singh during his address spoke on achievements of horticultural sector especially the importance of plantation crops in the economy of country and flagged various other issues such as the impending need for studies on carbon-sequestration in the wake of climate change, mapping of nutrient status of soils where plantation crops are grown etc.

Dr. P. Rethinam, former ADG (Plantation Crops) & Former Executive Director, Asian and Pacific Coconut Community (APCC), Jakarta, Indonesia and former Chairman, Coconut Development Board who delivered the Dr. K.V. Ahmad Bavappa Memorial lecture emphasized on importance of adoption of novel science and technological applications such as Internet of Things (IOT), precision farming etc and highlighted the economic scenario and road ahead for development of plantation crops sector.

Dr. Pandey in his address appreciated the significant achievements of ICAR-CPCRI and stressed the opportunities plantation sector offer for the scientific community in particular and the growers in general.

In Dr. A. K. Singh released various publications brought out by the Institute viz., a book on "The Coconut Genome", E-book on Scientific Coconut Farming - Seed to Market (in Malayalam), audio compilations on arecanut cultivation (in Kannada and Malayalam), and a series of four extension folders pertaining to integrated the disease management practices in coconut (in Kannada).

Dr. A.K.Singh distributed the CPCRI Annual Awards to the selected staff of the Institute. The award for the Best Scientific Team Research was conferred to an inter-disciplinary team headed by Dr Rajkumar, Scientist for the team's work on management of root grubs of arecanut. Mr. C. Purandhara and Mr. Ibrahim were awarded in Technical and Skilled Supporting Staff Categories, respectively.

A farmers' training programme on 'Micro-irrigation for coconut' was conducted as part of the foundation day celebration. Selected farmers from five micro-watersheds in Kasaragod district under the NABARD assisted scheme attended the training programme organised in collaboration with Centre for Rural Development (CRD) Nileswar. Dr. A.C.Mathew, Principal Scientist co-ordinated the farmers' training programme.

The initiative of CPCRI to provide technical support for establishing one hectare coconut garden in the Open Prison& Correctional Home campus at Cheemeni was inaugurated in the offline function held in the PJ Hall at CPCRI Kasaragod. Dr. Anitha Karun handed over coconut seedling to Mr. Sudheer. T, Superintendent, Open prison Cheemeni.

Mr. Sivaprasad, farmer representative and Secretary, Watershed committee, Mugu watershed under NABARD assisted scheme, offered felicitations

Dr. Anitha Karun, Acting Director, ICAR-CPCRI welcomed the gathering and Dr. C. Thamban, Acting Head, Division of Social Sciences, ICAR-CPCRI proposed vote of thanks.

Report by Dr S. V. Ramesh and Dr. Thamban. C, ICAR-CPCRI Kasaragod

141st Meeting of Coconut Development Board held

The 141st Meeting of the Coconut Development Board was held on 27th December 2021 under the Chairmanship of Shri Rajbir Singh IFS, Chairman, Coconut Development Board through hybrid mode.Members of the Board, Dr. Anitha Karun, Member Director, CPCRI, Shri Manish Kumar IRS,Principal Commissioner Central Excise, Customs & Service Tax, Shri Subhash Chandra Meena IES, Director, Department of Consumer Affairs Govt. of India, Shri C. Samayamoorthy IAS, Agricultural Production Commissioner & Secretary to the Government of Tamilnadu, Shri Naba Kishore Tad, Deputy Director of Horticulture, Government of Odisha, Dr. B. Ramakichenin @ Balagandhi, Director, Directorate of Agriculture & FW Govt. of Puducherry, Shri P. Reghunath, Shri K. Narayanan Master, Shri S.V. Muthuramalingam, Shri Renukumar B.H, Shri H.L. Aswathnarayana, Shri Guruswamy D, Shri R. Elango, Shri Prasad K.N, Joint Director of Horticulture representing the Director of Horticulture, Government of Karnataka and Shri M. Venkateswarlu, Additional Director of Horticulture, representing the Commissioner of Horticulture, Government of Andhra Pradesh, Shri Rajeev Bhushan Prasad, Chief Coconut Development Officer i/c., Coconut Development Board and Shri R. Madhu, Secretary, Coconut Development Board also attended the meeting. The Chairman informed the members about the major events that took place since the last Meeting of the Board, various exhibitions attended/ organized by the Board, progress made in the formation of FPOs, progress made in the export of coconut products and price scenario was highlighted during the deliberations.

Swachhata Pakhwada

Coconut Development Board at its Head Office and Unit Offices observed Swachhata Pakhwada campaign.

Agro Tech 2021

Coconut Development Board, State Centre, Vijayawada participated in Agro Tech 2021 conference and exhibition held at Guntur, Andhra Pradesh from 17th to 19th December 2021.

Onattukara Coconut Products creating presence in the International Market

Onattukara brand of coconut oil and a variety of value added products, acclaimed well by the public, are now reaching the international markets. Two pallets with 75 cartons of products were shipped from Cochin port on 26th December 2021 as the company's maiden effort. This prestigious step is a New Year gift to the Onattukara Company and its 4000 plus share holders.

Onattukara Coconut Producer Company is an initiative of coconut farmers of the region, which is predominantly an agricultural belt which brought fame and prestige to the State's agricultural scenario. Coconut paddy, banana and spices are widely grown here. Coconut in this region is unique in its nut size, higher oil content and taste.

The company was established as the 13th Coconut Producer Company in the series of Companies promoted by the Coconut Development Board in its three tier FPO formation during 2012-15. Incorporated on 3rd February 2015 the organization first ventured into coconut oil manufacturing and later on, on the value added products. The products range are Urukkuvelichenna (Coconut Milk Oil), Chutney Powder, Ginger Mix, Coconut Chips, Vegetable curry Mix, Coconut - rice mix, cake, squash, coconut pickle etc.

The oil manufacturing plant was inaugurated on 28th May 2017 by Shri. Pinarayi Vijayan, Hon'ble Chief Minister of Kerala in the presence of former Chief Minister Shri. Oommen Chandy, Malayalam cine fame artist Bharath Mammootty and several other dignitaries.

The four-year journey of the company was not smooth. Disturbances and financial crisis blocked the free movement. Working capital shortage was a hindrance to the full capacity utilization. The popularity of the company is on the quality it maintains. With the result, the total production is fully consumed by the local market.

The present export is to New Jersey, US, and the consignment will be deshipped on 1st February 2022. The Company is getting lot of enquiries from different market destinations. With the present export, it is hoped that Onattukara Products will reach the niche markets in US, UAE, UK etc within a short span of time.

Onattukara Company participated in Agro Fests in Thiruvanathapuram and Kottayam

Onattukara Coconut Producer Company participated in the Agro Fests held in Thiruvananthapuram and Kottayam districts organized by the Kerala Industries Department and the District Industries Centre respectively.

The Kerala Agro Food Pro was held during 17th and 20th December 2021 at Thycadu, Thiruvananthapuram which focused on food processing and value addition. Enhancing the manufacturing capabilities and competitiveness of agro food and processing Industries, providing a platform for exploring the domestic and international markets for agro food based MSMEs, introducing new ideas and trends in food and agriculture sector, conducting B2B meets, technology dissemination etc. were the key objectives of the event. Onattukara Company showcased its various products in the exhibition and the show provided opportunity to the company to initiate new business tie ups with various firms in and around Thiruvananthapuram and also export enquiries.

The Aghma Fest was held in Manarcadu, Kottayam during 17th and 21st December 2021 which focused on demonstration and sale of vegetables, fruits, machineries, agro processed foods, utility items, seeds of agricultural crops etc. A variety of organic fertilizers, organic pesticides and insecticides was the other major attraction of the Fest which was organized by Aghma in association with Manarcadu grama panchayath, DIC Kottayam and Agriculture Department. Aghma is conceived as an Association for Human rights and Motivate people and make Awareness among members. Participation in Aghma fest by Onattukara Company was an excellent experience which provided a better platform to showcase and sell its products.

Friends of coconut tree (FoCT)

Coconut Development Board in association with KVK, Lakshadweep and Department of UT of Lakshadweep conducted Friends of coconut tree (FoCT) skill development training programme at Amini island from 24th - 29th December 2021. Shri.P.P Mohamed Faizal, Hon'ble Member of Parliament, Lakshadweep inaugurated the programme.

Coconut Development Board, Regional Office Bangalore in association with ICAR-KVK conducted Friends of coconut tree (FoCT) skill development training programme at ICAR-KVK, Mangaluru From 13th to 18th December 2021.

Cultivation Practices for Coconut -February

Collection and storage of seed nuts

From the identified mother palms seed nuts should be carefully harvested and properly stored to prevent drying of nut water. Wherever the ground surface is hard, harvested bunch should be lowered to the ground using a rope.

Nursery management

Irrigation has to be continued. Weeding has to be done wherever necessary. If termite infestation is noted in the nursery drenching with chlorpyriphos (2ml chlorpyriphos in one litre of water) should be done. Spraying of water on the lower surface of leaves of seedlings can be done against spiralling white fly attack.

Shading

Shade has to be provided for the newly planted seedlings, if not already provided.

Irrigation

Irrigation has to be continued in coconut gardens. If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm. Drip irrigation is the ideal method of irrigation for coconut. The number of dripping points should be six for sandy soils and four for other soil types. Depending on the evaporation rate, quantity of water to be provided through drip irrigation system can be decided in different coconut growing tracts. In Kerala 30-35 litres and in Tamil Nadu and Karnataka 35-45 litres of water is sufficient per palm per day through drip irrigation system during January.

Moisture conservation

Mulching and other soil and moisture conservation practices should be adopted if not done earlier.

Plant protection

With the temperature shooting up high even in

January, it is all likely that the month of February is going to be very dry. Nights remain still cooler, humidity percentage slowly comes down and the evaporation level increases. The areas adjoining river and brackish water as well as midland regions favours emergence of sucking pests like rugose spiralling whitefly and other whiteflies during this period. Several coconut gardens in Kerala, Tamil Nadu, Andhra Pradesh, Karnataka and Lakshadweep Islands (Kavaratti and Minicoy) are heavily infested with rugose spiralling whitefly or nesting whiteflies or occurring in synergy. There will be a shift in the parasitism level favouring the pest population to flare up especially on juvenile palms and coconut nursery. The sooty mould scavenger beetle population recedes after the withdrawal of rainfall. Strict domestic quarantine in the transport of coconut seedlings or ornamental palms should be ensured. The sustenance of key pests like black headed caterpillar and slug caterpillars in endemic zones are to be understood keenly and management


Leaf and inflorescence damage


Shielding by fish net


Metarhizium infected grub

strategies evolved accordingly. The dry pathogens like leaf rot disease and basal stem rot disease could increase in the endemic regions as well.

▶ *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 / pongam 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 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, Metarhizium anisopliae @ 5 x 1011 /m3 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 in 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.

▶ *Rugose Spiralling Whitefly (Aleurodicus rugioperculatus)*

This period could also witness the establishment of the invasive rugose spiralling whitefly (Aleurodicus rugioperculatus) in new areas as well as re-emergence in already reported areas. The pest population is increasing very high due to favourable weather factors of high day temperature and fall in relative humidity. Presence of whitefly colonies on the under 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. Continuous feeding by whiteflies cause health deterioration in palms for which agronomic care is very critical.

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 based on soil-test recommendations and adequate watering to improve the health of juvenile and adult palms. Agronomic health management of palms is very crucial including planting of intercrops wherever possible to diversify volatile cues and improve microclimate disfavouring

Rugose spiraliing whitefly

Parasitized pupa

Encarsia guadeloupae

Sooty mould scavenger beetle

flare up of whitefly.

● No insecticide should be used as this causes resurgence of the pest and complete kill of the 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.

▶ *Nesting whiteflies (Paraleyrodes bondari and Paraleyrodesminei)*

In addition to the rugose spiralling whitefly, two more nesting whiteflies (Paraleyrodes bondari and Paraleyrodes minei) are found associated with palm leaflets. Nesting whiteflies are smaller in size (1.1 mm) than rugose spiralling whitefly (2.5 mm). The nymphs are flatter with fibreglass like strands emerging from dorsum whereas the nymphs of rugose spiralling whitefly are convex in shape. Adult nesting whiteflies construct bird's nest like brooding chamber and sustains in the chamber. *P. bondari* had X-shaped oblique black marking on wings with two minute projections on rod shaped male genitalia whereas *P.minei* is devoid of black markings on wings and possesses cock-head like genitalia. Nesting whiteflies compete with rugose spiralling whitefly and reduce the aggressiveness of rugose spiralling whitefly in many cases.

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

● Effective nitidulid predators belonging to Cybocephalus sp. were observed on the palm system and pesticide holiday is advised for conservation of biological control.

▶ *Black headed caterpillar, Opisina arenosella*

The coconut black headed caterpillar, *Opisina arenosella*, is a major pest distributed in almost all coconut growing tracts across the country especially along the water bodies during winter. The infested portions get dried and form conspicuous grey patches on the upper surface of the lower fronds. Severe pest damage results in complete drying of middle to inner whorl of fronds leaving a burnt appearance. Presence of black headed caterpillars, webbing of leaflets and occurrence of dried faecal matter on the leaflets are the characteristic features of pest incidence. In the absence of natural enemies in the new area of emergence, the outbreak becomes faster and expands at high speed. Damage results in tremendous reduction in photosynthetic area, decline in rate of production of spikes, increased premature nut fall and retarded growth. Extensive feeding of caterpillars causes a crop loss of 45.4% in terms of nut yield in addition to rendering the fronds unsuitable for thatching and other purposes. Farmers need not panic and this approach is one of the classical examples of successful augmentative biological control suppressed by natural enemies.

Management

● Regular monitoring of palm fronds for pest occurrence in endemic zones.

● Removal and destruction of 2-3 older and dried leaves harbouring various stages of the pest. The leaflets could be burnt to reduce the caterpillar/ pupal population.

● Domestic quarantine should be strengthened by not transporting coconut fronds from pest-infested zone to pest free zone.

● Augmentative release of the larval parasitoids viz., Goniozus nephantidis (20 parasitoids per palm)

and Bracon brevicornis(30 parasitoids per palm) if the pest stages is at third-instar larvae and above. The pre-pupal parasitoid (Elasmus nephantidis) and pupal parasitoid (Brachymeri nosatoi) are equally effective in pest suppression and are released at the rates of 49% and 32%, respectively for every 100 pre-pupae and pupae estimated.

- Before releasing, the parasitoids are adequately fed with honey and exposed to host odours (gallery volatiles) for enhancing host searching ability.
- Ensure adequate irrigation and recommended application of nutrients for improvement of palm health.

Leaf rot disease (*Colletotrichum gloeosporioides, Exserohilum rostratum*)

It is commonly observed on palms affected by root (wilt) disease wherein foliar necrosis of terminal spear leaf and adjacent leaves are registered. The disease is prominently noticed in the post-monsoon phase during the month of December. Affected leaves turn necrotic and are not detachable from the palm and remain intact. This disease could be initially observed as minute lesions which later enlarge, coalesce and cause extensive rotting affecting the photosynthetic efficiency of palms. The disease is endemic to root (wilt) affected regions of Southern Kerala

Management

- Need based pruning and destruction of affected spear leaf and other adjacent leaves in the terminal region
- Spot application of hexaconazole 2 ml in 300 ml water on the affected spear leaf region
- Soil test based nutrition for improving the health of the palm and ensure adequate irrigation

Basal stem rot disease *(Ganoderma spp.)*

It is a destructive disease observed in all coconut growing regions and found very severe in soils with higher pH and moisture stress condition. The pathogen invades the root system during early stages of infection that are not visibly noticed. Very severe in areas of Thanjavur, Tamil Nadu parts of East Godavari, Andhra Pradesh and Arsikara, Karanataka. The outer whorl of leaves turn yellowish, then gradually become brown and droop from their point of attachment and hang vertically downwards to form a skirt around the trunk apex. In course of time, the apex of the trunk shows tapering with the advancement of the disease, and bleeding symptoms

Leaf rot disease affected palm

Leaflets

may appear on the bole region. At the base of the stem a characteristic reddish brown discoloration develops, accompanied by the exudation of a brown viscous gummy substance. These brownish patches may extend up to one metre from ground level and at times bark pealing was also observed. Sometimes fruiting bodies (basidiocarp) of the pathogen develop from the affected trunk.

Management

- Avoid burning of trash and palm residues near the trunk to avoid trunk/root injury
- Removal of dead palms and palms in advanced stage of the disease as well as destruction of the boles and root bits of the diseased palms to remove disease inoculums.
- Isolation of neighboring healthy palms, by digging isolation trenches (60 cm deep and 30 cm wide) around the affected palm (1.2 m away from the base of the trunk).
- Application of neem cake (5 kg) fortified with Trichoderma harzianum(CPTD 28)talc formulation (50 g)per palm per year at six monthly intervals reduced the disease intensity.
- Root feeding of hexaconazole @ 2% (100 ml solution per palm) and soil drenching with 0.2 % hexaconazole or with 40 l of 1% Bordeaux mixture in the coconut basin are recommended

Correct and timely diagnosis of insect and mite pests as well as disease causing pathogens would be the key factors for the implementation of effective management solutions. Delayed detection would take a longer time for recovery from pest invasion. Hence, a close scrutiny of palms through effective scouting and timely diagnosis would form the basis in doubling income through increased production. Palm health management is very important to tackle pests and diseases in coconut. ■

(Prepared by: Thamban, C., Subramanian, P., ICAR-CPCRI Kasaragod and Joseph Rajkumar ICAR-CPCRI Regional Station, Kayamkulam)

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Market Review – December 2021

Domestic Price

Coconut Oil

During the month of December 2021 the price of coconut oil opened at Rs. 17000 per quintal at Kochi and Alappuzha market and Rs. 17500 per quintal at Kozhikode market. The price closed with a net loss of Rs. 1100 at Kochi and Alappuzha market and Rs. 1000 per quintal at Kozhikode market.

The price of coconut oil closed at Rs. 15900 per quintal at Kochi and Alappuzha market and Rs. 16500 per quintal at Kozhikode market.

During the month, the price of coconut oil at Kangayam market opened at Rs. 14667 per quintal and closed at Rs. 13000 per quintal with a net loss of Rs. 1667 per quintal.

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

	Kochi	Alappuzha	Kozhikode	Kangayam
01.12.2021	17000	17000	17500	14667
04.12.2021	16900	16900	17500	14600
11.12.2021	16700	16700	17400	14400
18.12.2021	16500	16500	17200	14200
24.12.2021	16500	16500	17000	13933
31.12.2021	15900	15900	16500	13000

Milling copra

During the month, the price of milling copra opened at Rs.10250 per quintal at Kochi and Alappuzha market and Rs. 10750 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 9500 per quintal at Kochi market, Rs. 9450 per quintal at Alappuzha market and Rs. 9800 per quintal at Kozhikode market with a net loss of Rs.750 at Kochi and Rs. 800 per quintal at Alappuzha market and Rs. 950 per quintal at Kozhikode market.

During the month the price of milling copra at Kangayam market opened at Rs. 9900 per quintal and closed at Rs.8600 per quintal.

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

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.12.2021	10250	10250	10750	9900
04.12.2021	10250	10200	10750	9800
11.12.2021	10150	10100	10600	9700
18.12.2021	10000	9950	10350	9400
24.12.2021	10000	9950	10350	9200
31.12.2021	9500	9450	9800	8600

Edible copra

During the month, the price of Rajpur copra at Kozhikode market opened at Rs. 19350 per quintal and closed at Rs. 19300 per quintal with a net loss of Rs. 50 per quintal.

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

01.12.2021	19350
04.12.2021	19400
11.12.2021	19100
18.12.2021	19000
24.12.2021	19700
31.12.2021	19300

Ball copra

The price of ball copra at Tiptur market opened at Rs. 17000 per quintal closed at Rs. 17500 per quintal with a net gain of Rs.500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)

01.12.2021	17000
04.12.2021	17200
11.12.2021	17800
18.12.2021	17200
24.12.2021	17500
31.12.2021	NR

*NR-Not reported

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.15350 per quintal and closed at Rs.15100 per quintal with a net loss of Rs.250 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.12.2021	15350
04.12.2021	15350
11.12.2021	15350
18.12.2021	15100
24.12.2021	15100
31.12.2021	15100

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs. 16444 and closed at Rs. 15556 per thousand nuts during the month with a net loss of Rs. 888 per thousand nuts.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 30000 per ton and closed at Rs.25000 per ton during the month with a net loss of Rs. 5000 per ton.

At Bangalore market in Karnataka, the price of coconut opened and closed at the same price during the month.

At Mangalore market in Karnataka, the price of coconut opened at Rs. 32000 per ton and closed at Rs.26000 per ton during the month with a net loss of Rs. 6000 per ton.

Weekly price of coconut at major markets				
	Nedumangad (Rs./1000 coconuts)#	Pollachi (Rs./MT) ##	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 ton) ##
01.12.2021	16444	30000	20000	32000
04.12.2021	16444	29500	20000	32000
11.12.2021	16444	28500	20000	32000
18.12.2021	16444	27500	20000	28000
24.12.2021	16000	27000	20000	28000
31.12.2021	15556	25000	20000	26000

International price

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.12.2021	212	222	267	399
11.12.2021	213	223	279	385
18.12.2021	214	223	291	371
25.12.2021	213	225	296	365

*Pollachi market

Coconut Oil

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

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
04.12.2021	1695	NR	1609	2917	1974
11.12.2021	1832	NR	1575	2959	1948
18.12.2021	1712	NR	1575	2952	1945
25.12.2021	1891	NR	1588	3111	1885

*Kangayam

Copra

The price of copra at Philippines and Srilanka expressed a mixed trend whereas India and Indonesia expressed a downward trend during the month. The price of copra quoted at different domestic markets in Philippines, Indonesia, and India are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
04.12.2021	942	954	1533	1312
11.12.2021	932	948	1542	1312
18.12.2021	936	941	1563	1271
25.12.2021	955	949	1618	1244

* Kangayam

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

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