

Indian Coconut Journal

Post monsoon rainfall and soil moisture conservation strategies

e- kalpa: Coconut information on your fingertips



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Articles, research papers and letters on different aspects of coconut cultivation and industry are invited for publication in this Journal. All accepted material will be paid for. The Board does not accept responsibility for views expressed by contributors in this Journal. All remittances and correspondence should be addressed to the Chairman, Coconut Development Board, Kochi - 682 011.

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 Neriya Mangalam (Kerala), Vegiwada (Andhra Pradesh), Kondagaon (Chhattisgarh), Madehpura (Bihar), Abhayapuri (Assam), Pitapalli (Orissa), Mandya (Karnataka), Palghar (Maharashtra), Dhali (Tamil Nadu) and South Hichachara (Tripura) 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 friends,

As I put pen to paper, what comes to my mind is T.S.Eliot's poem, Burnt Norton

*"Time present and time past
Are both perhaps present in time future,
And time future contained in time past."*

To put things in a simple fashion, the New Year reminds us that it is time to look forward with lessons learnt from the past. And 2019 is going to be a year in which confluence of technologies will occupy the centre stage. These range from block chain, 3D printing, quantum computing, drones and robotics to gene mapping and artificial intelligence. Quantum computers for instance make use of qubits which have exponential computing power paving the way for quantum algorithms that can optimize global manufacturing supply chains. Drones on the other hand, in their avatar as drone taxis present a unique solution to both road congestion and the attendant need for mammoth capital eating infrastructure. Dubai has already created corridors upto 200 feet over a 10 kilometer stretch that allows free and easy movement of drones. And India can very well follow suit.

A recent paper by the Director, Indian Institute of Management, Ahmedabad speaks of IBM's Watson having come up with predictions of enzymes that would turn on or off proteins such as p53 that curb the growth of cancers after exposing the machine to 70000 papers on the topic. Add to these, the IoT (Internet of Things)- the ex-factor, the modern day Midas touch which you find everywhere from optimized power grids to farm equipments and pest control- and the picture is complete. And it needs to be mentioned here that surgeons operating on patients from hundreds of kilometers away, drones flying into help, appliances speaking to each other at home are no longer impossibilities. Thanks to the fifth generation or 5G radio technology.

Needless to say, a profound impact of this technological revolution will be felt in the agricultural sector too where a digital revolution is already sweeping across. For instance the time is not far off when the power of 5G, nay 5G-enabled Internet of Things will be used to usher in smart agriculture. And that is just the tip of the iceberg. It is in keeping with the tune of these times when the world of technologies is brimming with innovations that Coconut Development Board is trying to infuse them into farming – the oldest profession in India. The Board for instance is teaming

up with CSIR- Central Food Technological Research Institute (CFTRI) Mysuru for the creation of a sensory lexicon and for the development of coconut based produce for sustenance in sports. The Board has also approached the All India Institute of Medical Sciences to conduct studies on the effect of Virgin Coconut Oil on cardio metabolic parameters in patients with dyslipidemia and in preventing oral cancer. These studies are expected to provide conclusive scientific evidence to the health attributes that this wonder crop is believed to possess – adding on to the Unique Selling Propositions (USP's) of coconut products which will ultimately help in expanding and stabilising the market space for coconut.

The Board in collaboration with the IISc and CPCRI is also working towards using artificial Intelligence and drones for early detection of pests and diseases. We are also trying to popularise coconut ice cream vending machines developed by the Indian Institute of Food Processing Technology, Thanjavoor. The Board has requested the Central Agricultural University, Imphal, Manipur to develop a road map and a prospective plan for the comprehensive development of coconut cultivation and value addition in the North East. And other initiatives too are in the pipeline.

To conclude, coconut industry has unlimited potential for value addition, product development and by product utilization. India is the world leader in coconut production and productivity and in this New Year let us strive together to make our country the global leader in processing and value addition of coconut. This will also lead to the fulfillment of the vision of the Government of India to double the farmers income by 2022.

As Peter Drucker once said, "the best way to predict the future is to create it!". Armed with nimbleness and flexibility to change, let us gaze at the future, embrace the new technologies and bring them to the doorsteps of the farmers- triggering a sustainable make over.

A happy and prosperous New Year to one and all.

Dr. Raju Narayana Swamy IAS
Chairman



Impact of post monsoon rainfall and soil moisture conservation strategies to sustain Coconut productivity

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Introduction

Success of coconut farming is mostly determined by favorable climatic factors, optimum supply of water, nutrients and other inputs. Among the climatic factors, rainfall plays a crucial role in increasing coconut productivity. Millions of families in India depend directly or indirectly on coconut for their livelihood. The annual coconut production in India is 23.90 billion nuts from an area of 2.08 million ha with an average productivity of 11481 nuts/ha (CDB 2016- 17). The four southern states in India viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are the major coconut producing states, accounting for more than 90 percent of area and production. Indian agriculture is mainly dependent on the monsoon rain and 75 % of the rainfall is received during the south west monsoon (June to Sept.), benefiting most of the coconut growing regions. Along the east coast, in the main coconut growing areas of Tamil Nadu and Andhra Pradesh, the north east monsoon (October to December) accounts for major rainfall. Occurrence of both the monsoons are equally important for successful coconut cultivation in the country. This is mainly because of the fact that after the cessation of monsoon there is no rainfall till the receipt of good summer showers during the first fortnight or end of May. Hence normal monsoon followed by few post monsoon showers ensure availability of sufficient soil moisture till January end and thereafter depletion of soil

moisture results in soil moisture deficit. The situation gets aggravated after March. Therefore the survival of palms during the period between January to May is mainly dependent on post monsoon rains.

In recent years, sustainable production of coconut is in danger owing to erratic behavior of monsoon and post monsoon rains and frequent droughts result not only in decline in productivity and also mortality of palms in extreme cases. Hence an effort was made to analyze the post monsoon rainfall data for the year 2018. Its effect on coconut yield and mitigation measures for the same are suggested below.

Occurrence of north east monsoon during 2018

Rainfall received during the post monsoon season (October to December) of 2018 in major coconut growing districts of southern states is presented in tables 1 to 4 and depicted in figures 1 to 4.

Tamil Nadu

The rainfall received during October to December, 2018 in Tamil Nadu clearly revealed that 13 districts out of 21(considered districts having >6000 ha coconut area) received less rainfall than the normal which falls under the category of deficit, two districts viz., Kanyakumari and Tirunelveli districts received excess rainfall (Table 1 and Fig 1) and 6 districts viz., Krishnagiri, Namakal, Salem, Thoothukudi, Tirupur and Vellore districts received normal rainfall. (Table 1 and Fig.1).

Table 1. Comparison of normal and actual rainfall received during October- December 2018 in the major coconut growing districts of Tamil Nadu

Districts	Area (ha)	Normal RF (mm)	Actual RF (mm)	% Deviation	Category*
Coimbatore	85832	328.9	182.5	- 45	D
Dindigul	30538	436.4	325.1	-25	D
Dharmapuri	7974	330.1	254.7	-23	D
Erode	14301	314.6	196.4	-38	D
Kanyakumari	23988	496.4	611.2	23	E
Karur	6640	314.7	234.3	-26	D
Krishnagiri	15612	289.4	329.7	14	N
Madurai	10876	419.1	286.5	-32	D
Namakkal	8269	291.6	256.6	-12	N
Pudukottai	9456	406.2	207.5	-49	D
Ramanathapuram	8292	491.7	259.1	-47	D
Salem	13635	370.5	341.9	-8	N
Sivaganga	7098	422.7	259.1	-39	D
Thanjavur	36136	550.3	433.7	-21	D
Theni	20931	357.9	280.7	-22	D
Thiruchirapally	6070	391.5	223.7	-43	D
Thoothukudi	6013	427.0	353.7	-17	N
Tirunelveli	16248	467.2	665.4	42	E
Tirupur	60148	314.3	255.6	-19	N
Vellore	20523	348.7	338.8	-3	N
Virudhunagar	10156	419.0	332.3	-21	D

*D = deficit (Percentage deviation of realised rainfall from normal rainfall is between - 20 % to - 59 %), N = normal (Percentage deviation of realised rainfall from normal rainfall is between - 19 % to + 19 %), E= Excess (Percentage deviation of realised rainfall from normal rainfall is + 20% or more.)

Source: IMD, 2019

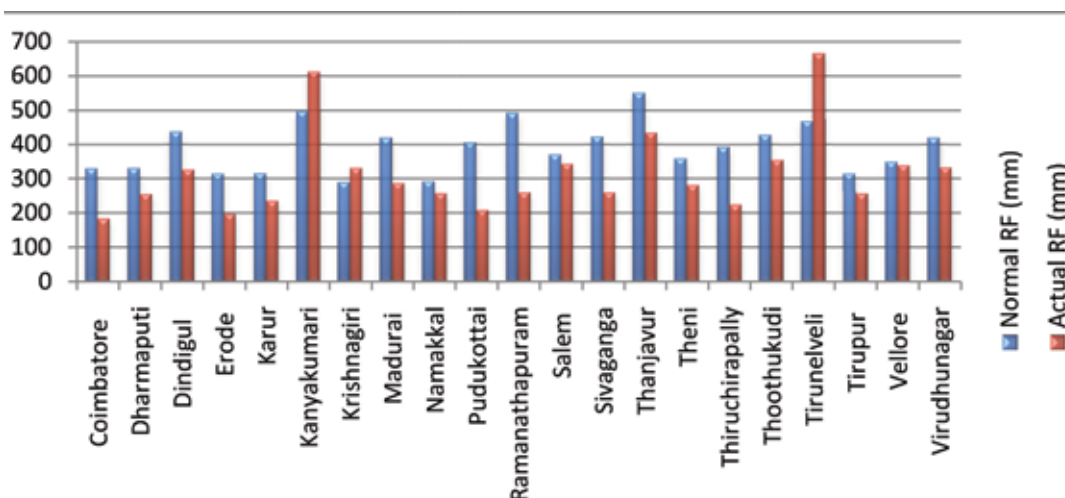


Fig.1

Kerala

Rainfall received during the post monsoon season of major coconut growing districts of Kerala revealed that except Alappuzha, Ernakulam and Idukki districts, others recorded either less or excess rainfall. The highly affected district is Palakkad. (Table 2 and Fig. 2)

Table 2. Comparison of normal rainfall vs actual rainfall received during October- December 2018 for coconut growing districts of Kerala

Districts	Area (ha)	Normal RF (mm)	Actual RF (mm)	% Deviation	Category*
Alappuzha	33676	572.1	489.4	-14	N
Ernakulam	43079	489.3	539.0	10	N
Idukki	16122	564.2	494.0	-12	N
Kannur	88217	345.1	246.1	-29	D
Kasaragod	65243	337.9	180.1	-47	D
Kollam	50938	638.6	950.0	49	E
Kottayam	25610	535.1	645.0	21	E
Kozhikode	119064	422.2	271.5	-36	D
Malappuram	102836	448.3	343.7	-23	D
Palakkad	59547	428.0	177.4	-59	D
Pathanamthitta	15877	624.2	928.3	49	E
Thiruvananthapuram	70467	522.7	667.4	28	E
Thrissur	80540	469.4	318.4	-32	D
Wayanad	10322	332.5	165.0	-50	D

*D = Deficit (Percentage deviation of realised rainfall from normal rainfall is between - 20 % to - 59 %), N = Normal (Percentage deviation of realised rainfall from normal rainfall is between - 19 % to + 19 %), E= Excess(Percentage deviation of realised rainfall from normal rainfall is + 20% or more.)

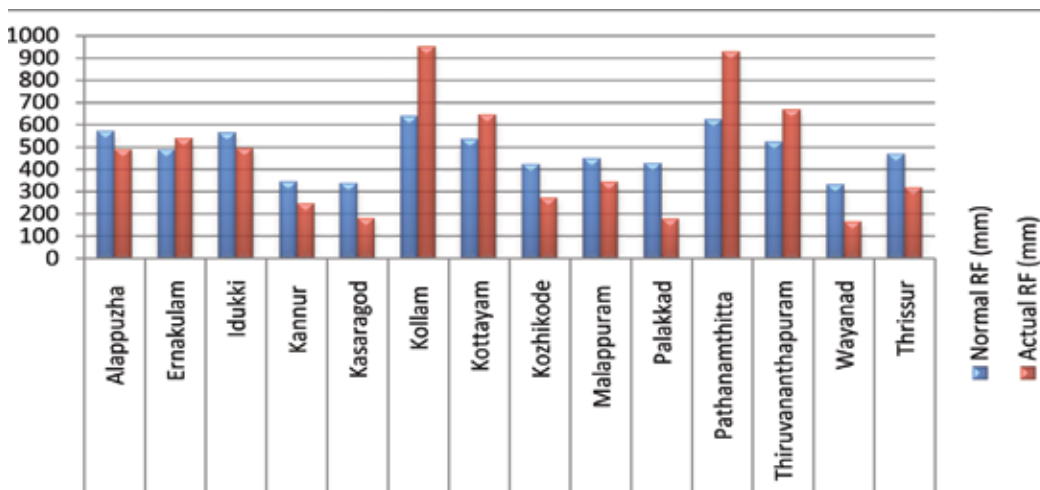


Fig.2

Karnataka

Rainfall received during the post monsoon season in major coconut growing districts of Karnataka (considered districts having >7000 ha coconut area) revealed that except Chamarajanagar, Davangere, Ramnagar, Mandya and Udupi, other districts of Karnataka recorded either less or excess rainfall. The highly affected district is Chikmagalur (- 45) (Table 3. and Fig 3)

Table 3. Comparison of normal rainfall vs actual rainfall received during October- December 2018 for major coconut growing districts of Karnataka

Districts	Area (ha)	Normal RF (mm)	Actual RF (mm)	% Deviation	Category*
Chamarajanagar	9130	244.8	237.3	-3	N
Chikmagalur	41114	238.5	131.7	-45	D
Chitradurga	40576	159.0	196.5	24	E
Dakshina Kannada	18467	334.5	248.4	-26	D
Davangere	10011	176.7	194.7	10	N
Hassan	60472	221.0	131.8	-40	D
Mandya	24629	214.1	198.3	-7	N
Mysore	16712	214.3	142.7	-33	D
Ramanagar	18242	243.1	267.1	10	N
Udupi	17922	317.2	345.8	9	N
Tumkur	152341	205.7	250.0	22	E
Uttar Karnataka	7787	210.4	155.2	-26	D

*D = Deficit (Percentage deviation of realised rainfall from normal rainfall is between - 20 % to - 59 %.), N = Normal (Percentage deviation of realised rainfall from normal rainfall is between - 19 % to + 19 %.), E= Excess (Percentage deviation of realised rainfall from normal rainfall is + 20% or more.)

Andhra Pradesh

Rainfall received during the post monsoon season of major coconut growing districts of Andhra Pradesh revealed that except Chittoor and Srikakulam, other districts of Andhara Pradesh, recorded less than normal rainfall. (Table 4 and Fig. 4). The worst affected districts are East Godavari and West Godavari (-55 %).

Table 4. Comparison of normal rainfall vs actual rainfall received during October- December 2018 for major coconut growing districts of Andhra Pradesh

Districts	Area (ha)	Actual RF (mm)	Normal RF (mm)	% Deviation	Category*
Chittoor	3465	418.4	362.9	15	N
East Godavari	50490	125.7	276.6	-55	D
Krishna	1872	127.5	242.4	-47	D
Srikakulam	14753	243.2	286.1	-15	N
Vissakapatnam	7300	133.2	267.8	-50	D
Vizianagaram	2793	193.5	250.5	-23	D
West Godavari	21818	124.7	276.2	-55	D

*D = Deficit (Percentage deviation of realised rainfall from normal rainfall is between - 20 % to - 59 %.), N = Normal (Percentage deviation of realised rainfall from normal rainfall is between - 19 % to + 19 %.), E= Excess (Percentage deviation of realised rainfall from normal rainfall is + 20% or more.)

It is clear from the post monsoon data that major part of the coconut growing area in the Peninsular India received deficit rainfall. This will adversely affect the coconut productivity under rainfed conditions (no irrigation) and even under irrigated

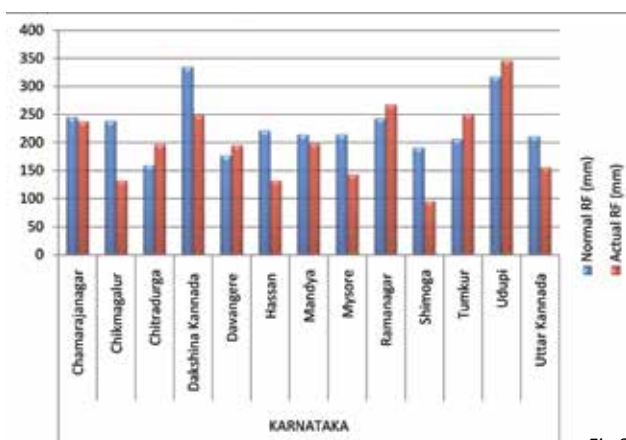


Fig.3

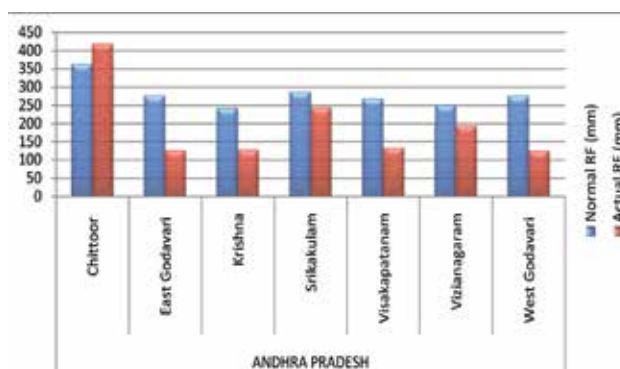


Fig.4

conditions it may pose serious problem during the later part of summer season due to drying up of the irrigation water sources. Hence for sustaining coconut growth and production it is imperative to adopt water conserving and drought mitigating measures including short, medium and long term measures.

Impact of moisture stress on coconut seedlings

A rainless period of more than 10 to 15 days, depending upon the soil type, will cause water stress in seedlings and result in scorching of leaves, followed by wilting of the seedlings. If the duration of stress is prolonged, it ultimately leads to the death of seedling. So in the initial stages of seedling growth (up to a period of three years), life saving irrigation (when grown under high rainfall zone as rain fed crop) or regular irrigation (in dry areas or low rainfall zone) is essential for the survival and successful establishment of the palm.

Impact of moisture stress on adult coconut palms

Deficit soil moisture adversely affects the growth of different parts of the palm to varying degrees, adversely affecting productivity of the coconut palm to a great extent.

Effect on vegetative growth

The absence of adequate moisture in the soil affects the leaf water potential and the absorption of nutrients. Drought conditions cause drying and death of roots which affect the absorption and transportation of water and nutrients from the soil. Inadequate moisture availability in the soil affects solubility and movement of nutrients and absorption of nitrogen and potassium has been shown to

be below optimum under inadequate moisture conditions. Moisture stress and poor absorption of nutrients leads to yellowing of lower leaves, drying of leaves and petiole breakage. Breakage of leaf petiole is the typical symptom of the palms affected by drought. The dried leaves then fall off, leaving only a few green leaves on the crown. Subsequently these top leaves also fall off and even a low velocity wind results in to de-topping and death of the palms (Fig. 5)

Effect on yield and yield attributes

Soil moisture availability influences inflorescence initiation and female flower development and water deficiency can result in abortion of spadices. In addition to total absence of the inflorescence in some of the leaf axils, emergence of inflorescences without female flowers, delay in opening of spathes, shedding of fertilized female flowers (buttons) and immature nut fall are also observed to occur due to moisture deficit stress. Further the production of leaves is affected resulting in a reduction in the number of bunches produced. Soil moisture stress also results in bunch drooping and buckling, poor nut set, poor endosperm development and reduction in size of nuts as well as copra content.

Considering the long duration of 44 months from the initiation of inflorescence primordia to nut maturity, there are different stages at which moisture stress can detrimentally affect nut yield. It is noteworthy that about 70 per cent of this period falls in the pre-fertilization phase and only 30 per cent falls in the fertilization and post-fertilization phases. Thus palms affected by drought take at least two to three years to recover completely impacting palm productivity and income to the farmer (Rajagopal *et al.*, 1996).



(Fig. 5) Effect of moisture stress on coconut palm

1. Yellowing and drooping of lower leaves
2. Yellowing and drooping of lower leaves Petiole breakage, a typical symptom of moisture deficit stress
3. Drought affected palm, with only central whorl of leaves
4. De-topping and death of drought affected palm

Deficit post monsoon rains have a negative impact on water availability and it is imperative to use each and every drop of available water more effectively for crop production. Hence the method and system of irrigation along with soil moisture conservation is important and should ensure saving of water, energy and labour and focus on higher Water Use Efficiency (WUE). It is necessary to adopt management practices in a holistic approach on a long term basis owing to the perennial nature of the coconut palm. The principle of CATCH, COLLECT and UTILIZE the rainfall is of paramount importance. The following soil moisture conservation measures could be adopted in the coconut plantation to overcome adverse impact of drought owing to erratic behavior and failure of monsoon rains.

I. Soil and water conservation measures

Mulching coconut basins

Mulching is the simplest and most effective moisture conservation practice for sustainable coconut production. In order to conserve soil moisture in coconut plantations, mulching with various types of organic materials viz., coconut leaves, husk and coir pith can be practiced (Fig. 6). Mulching not only helps in reducing soil temperature and evaporation of moisture from soil surface, it also creates an ambient condition for proper root growth and proliferation of soil flora and fauna. The timing of mulching is crucial for effectively conserving soil moisture. Mulching the area around the base of the palm (1.8 - 2.0 m radius) before the end of monsoon (and before the top soil dries up) will help retain soil

moisture and prevent the ground from becoming hard and thus help lessen the adverse effects of drought conditions and promote growth of the palms.

For mulching, coconut leaves should be cut into two or three pieces and arranged in two to three layers in the coconut basins. About 15 to 25 fallen coconut leaves would be required to cover 1.8 m radius of a coconut basin.

Coconut husk and coir pith can hold moisture to the tune of three to five times of their weight and hence are ideal for mulching the basins and promote soil moisture conservation. Besides conserving soil moisture, coconut husk is an important organic material and a good source of plant nutrients. On an average husk constitutes 45% of the weight of nut and on this basis, a nut weighing 1,000 g will have 450 g of husk with 20% moisture. Approximately 250 to 300 husks would be required for one coconut basin. Decomposition of the mulches after a period of time results in enrichment of soil organic matter pool. On dry weight basis, the average composition of husk is 0.23% N, 0.04% P, 0.78% K, 0.08% Ca and 0.05% Mg. For mulching one coconut basin with coir pith to 10 cm thickness, approximately 50 kg coir pith would be required. Due to its fibrous and loose nature, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil and thereby increases the coconut productivity. Mulching of coconut basins can also be done with other organic wastes such as completely dried weeded material.



Dried coconut leaf mulch



Coconut husk mulch



(Fig. 6) Organic mulching materials

Timing of mulching as soil moisture conservation measure

Timing of mulching is very important. As a soil moisture conservation measure, mulching should be done before the soil moisture is depleted and preferably when the available soil moisture is at field capacity. If it is not done earlier, then before applying mulches the basin of coconut palm (1.8 m radius) should be fully irrigated (300 to 400 liters of water) to reach field capacity.

Contour trench filled with coconut husk

This measure is to be taken up where the land slope is high (7-22%). Trenches of 50 cm width and 50 cm depth and of convenient length (preferably 4 m length) are to be made (across the slope) in between two rows of coconut palms. The trench should be dug in such a way that it would not come in line with the basin area and will trap the water flowing down the slope from the area in between the coconut basins. These trenches are to be filled with layers of coconut husk, with the bottom layers facing up (concave side up) and top layer facing down. A bund of 50 cm height and suitable width (50 cm) is to be made at the downstream of the trench using the excavated soil. To stabilize the bund, two rows of pineapple plants are to be planted on the bund at a spacing of 20 cm x 20 cm (Fig. 7). Pineapple plants in addition to stabilizing the bund, would also provide additional income to the farmer. The runoff water from the upstream, along with soil particles in the runoff water gets collected in the trenches. The coconut husk retains the moisture for a longer period and makes it available for plants during summer months. Adoption of this intervention in coconut plantations (in farmers holdings), was effective in soil

and water conservation, with 98% reduction in the soil loss (0.14 t/ha) as compared to control (10.52 t/ha) and recorded lesser water runoff (0.17%) as compared to control (5.6%). Similar results were obtained in terms of nutrient conservation, with minimum nutrient loss (1.28, 0.20 and 1.15 kg/ha/year N, P₂O₅, K₂O, respectively) as compared to control (105, 22 and 167 kg/ha/year N, P₂O₅, K₂O, respectively), with a per hectare yearly nutrient saving of 103.7 kg nitrogen, 21.8 kg phosphorus and 166.85 kg of potassium. A positive effect on coconut yield under rain fed conditions was also observed (over a four year period), with a 162 % increase in coconut yield (93 nuts/palm/year), over pretreatment yield (35 nuts/palm/year), as a result of these management practices.

Half moon bund with two rows of pineapple

This is another effective method for conserving precarious natural resources, viz. soil and water and has been successfully demonstrated in coconut plantations. This measure is to be taken up where there is mild slope. Here a flat basin with a slight inward slope in the upstream is made by excavating soil from the upstream side and shifting the excavated soil to the downstream side. A bund of 50 cm height and 50 cm width is made at the downstream side of the coconut palm using the excavated soil. Two rows of pineapple plants are to be planted on the bund, with a spacing of 20 cm row to row and 20 cm plant to plant (Fig. 8). The bund prevents runoff and water gets collected within the basin and percolates down. Roots of pineapple act as a reinforcement to stabilize and protect the bund, in addition to giving additional income to the farmer through fruit yield. About 94% reduction in soil loss (annually to the tune of



Fig. 7. Contour trench filled with coconut husk



Fig.8 .Half moon bund



Fig. 9. Catch pit with pineapple border

0.59 t/ha as against 10.52 t/ha in control) was recorded in farmers gardens, due to adoption of this simple technology. Similarly, less nutrient loss was also observed (3.30, 0.83 and 4.18 kg/ha/year N, P₂O₅, K₂O, respectively) as compared to control (105, 22 and 167 kg/ha/year N, P₂O₅, K₂O, respectively). Higher soil moisture content was observed even during post monsoon period, up to four months after cessation of rains, in comparison to control wherein the coconut palms reached almost close to permanent wilting point within two months after cessation of rains. Along with the reduction in runoff, soil erosion, nutrient loss, 63% increase in yield (70 nuts/palm/year) over pre treatment yield of 43 nuts/palm/year was also recorded (Mathew *et al.*, 2018).

Staggered catch pit

Catch pit technology is very effective in conserving soil and water resources and can be constructed in all slopes. By adopting this technique, the soil loss was 0.69 t/ha/year and the nutrient loss was 2.71, 0.56 and 3.87 kg/ha/year, N, P₂O₅ and K₂O, respectively. Though there are no standard dimensions for catch pits, for convenience catch pits of 1.5 m length x 0.5 m width x 0.5 m depth can be adopted. A bund is to be made downstream of the catch pit using the excavated soil and strengthened by planting pineapple plants (Fig. 9). This pit may or may not be filled with coconut husk. If it is without husk, periodic measurement of the depth of the pit indicates the amount of soil collected inside the pit, a direct measurement of soil erosion. Remarkable impact of catch pit on coconut palm yield was observed at ICAR-CPCRI, with a 96% increase (49 nuts/palm/year) over the pre treatment yield (25 nuts/palm/year).

Coconut husk or leaf burial in interspaces

Husk or leaf burial in interspaces can be undertaken in any coconut plantation, for moisture conservation. Trenches of 120 cm width x 60 cm depth and convenient length can be made in between two rows of coconut palms. These trenches are then filled with coconut husk and/or coconut leaves (Fig. 10). Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down. The top portion of the trenches are filled with coconut leaves and finally covered with soil.

Efficient water management

Deficit monsoon rains have a negative impact on water availability, resulting in water becoming a critical input. So it is imperative to use each and every drop of the available water more effectively for crop production and hence the method of irrigation and system of irrigation is more important and should ensure saving of water, energy and labour and focus on higher Water Use Efficiency (WUE) and drip irrigation is an ideal method of irrigation for coconut. However to reap the full benefit of drip irrigation, it is essential that sufficient care is taken to ensure proper installation of the system for effective delivery of water in the subsurface and in the active root zone. Studies on root absorption in coconut indicate an active absorption zone 0.75 m to 1.25 m from the bole and hence it is recommended to place the emitter/micro tubes in the centre of that area (about 1 m from bole). Further, loss of water through evaporation can be reduced by adoption of sub surface irrigation, allowing the



Fig.10 . Coconut husk or leaf burrial in interspace

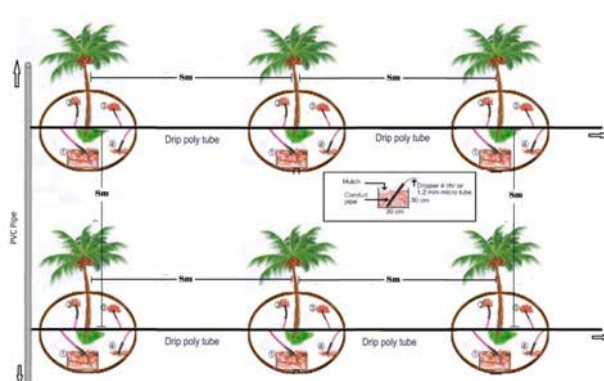


Fig. 11 Layout of drip irrigation in coconut

water to drip at 30 cm depth by making a pit of 30 cm-3. The pit should be filled with locally available mulch or coir pith (if available nearby). To facilitate effective sub surface delivery of irrigation water, a conduit pipe of 40 cm may be placed diagonally and water allowed to drip through that pipe. By this subsurface placement, evaporation is minimized and the volume of wetted soil was 35% more than the surface placed emitters (Fig. 11). Further, fertilizers also can be applied through drip irrigation system, thus ensuring efficient use of both water as well as fertilizers.

Integrated nutrient management

Application of sufficient quantities of organic manure in a regular interval will not only improve soil structure, but also improve its nutrient status to support growth of the coconut palms. Organic matter addition enhances moisture retention capacity and reduces the bulk density of the soils, thereby increasing aeration, drainage and water intake of soils. Farmyard manure, composted crop and animal residues, vermicompost and green leaf manure and other biodegradable wastes can be effectively used in the coconut groves to improve the soil texture and nutrient levels. Application of farmyard manure/compost/green leaf manure @ 50 kg per palm/year along with inorganic NPK (based on soil test value), will improve nutrient availability to the palm for sustained coconut production. Results from the long term manurial experiment at ICAR-CPCRI Kasaragod also indicated higher coconut productivity under integrated nutrient management in rain fed cultivation.

Circular basins of 1.8 m radius and 20 cm depth may be dug and green leaf or compost or farm yard manure @ 50 kg per palm may be spread in the basin.

The availability of recyclable biomass from a well-managed coconut garden with 175 trees/ ha. has been estimated as 15 tonnes /ha/year in the form of leaves, spathe, bunch waste and husk. By effective recycling of these biomass in the coconut garden through vermicomposting, mulching and other soil moisture conservation measures would help in improving the physical, chemical and biological properties of soil. The increased organic content in the soil will also enhance its water retention capacity in the sandy soils. In clayey soils, it will help in loosening the structure and make it more porous, thus facilitating better aeration in the root zone and good drainage. It will also help in efficient intake of water and nutrients.

Conclusion

Water becomes a dwindling resource day by day and there won't be any change in future too. Hence it is imperative to use this most important resource in an effective manner. In this context sustainable coconut cultivation heavily depends on the systematic and scientific adoption of soil moisture conservation measures with integrated nutrient management practices

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Rajagopal, V., Shivshankar, S., Kasturibai, K.V., Voleti, S.R. 1988. Leaf water potential as an index of drought tolerance in coconut. *Plant Phys Biochem* 15:80-86. ■

developed an Android mobile application 'e- kalpa' for catering to the multiple information needs of farmers of coconut growing states. Farmers can download e- kalpa, free of cost from Google Play store and utilize the scientific information both online and offline modes.

Know about e- kalpa: the mobile App

e- kalpa provides information as technology

snippets which are available in 'Knowledge base'. The technology snippets can be accessed in multi lingual mode- English, Malayalam, Kannada and Hindi.

a. How to install e- kalpa: e- kalpa could be installed from Google play store in Android mobile phones by anyone free of cost. Type e- kalpa in Google play store and download. Once downloaded, it is accessible in offline mode also. Presently more than 3000 farmers have downloaded this application.

1.	Coconut recipes for micro entrepreneurs	i) Coconut chutney powder ii) Coconut laddoo iii) Mature coconut water squash iv) Coconut candies v) Coconut vinegar vi) Coconut pickle vii) Coconut water ready to serve
2.	Coconut based farming systems and soil/moisture conservation methods	i) Coconut based high density multi species cropping system (HDMSCS) ii) Coconut based mixed farming system iii) Glyricidia alley cropping iv) Growing of inter crops in coastal sandy soil with soil and moisture conservation measures v) Intercropping of medicinal plants in coconut garden
3.	Coconut based mushroom cultivation, flower cultivation	i) Commercial cultivation techniques of Heliconia stricta in coconut gardens ii) Growing edible mushrooms on coconut residues iii) Intercropping Marigold and Gomphrena in coconut garden
4.	Coconut varieties	i) Chandrakalpa ii) Chandralaksha iii) Chandrasankara iv) Chowghat Orange Dwarf v) Kalpadhenu vi) Kalpaharitha vii) Kalpajyothi viii) Kalpamithra ix) Kalpapratibha x) Kalparaksha xi) Kalpasamrudhi xii) Kalpasree xiii) Kalpasreshta xiv) Kalpasurya xv) Kalpatharu xvi) Kerachandra xvii) Kerakeralam xviii) Kerasankara
5.	Diseases and management	i) Bud Rot disease ii) Immature nut fall iii) Leaf blight or grey leaf spot disease iv) Root (wilt) disease v) Stem bleeding disease vi) Thanjavur wilt/ Ganoderma wilt/ Basal stem rot disease vii) Boron deficiency symptoms and management in coconut viii) Leaf rot disease
6.	Fertilizer application methods	i) Biofertilizers ii) Coir pith composting iii) Drip fertigation in coconut iv) Integrated nutrient management in coconut v) Nutrient deficiency symptoms and their management in coconut vi) Soil sampling in coconut vii) Vermicomposting of fallen coconut leaves viii) Boron deficiency and its management in coconut
7.	Harvest and post harvest technologies	i) Agricultural waste fired coconut chips dryer ii) Agricultural waste fired virgin coconut oil cooker iii) Coconut chips dryer (electrical) iv) Coconut pulverizer v) Coconut testa removing machine vi) Coconut de-shelling machine vii) Coconut milk expeller with cooling mechanism viii) Coconut slicing machine (electrical) ix) Coconut slicing machine (manual) x) Device to collect unfermented fresh and hygienic Neera xi) Double screw coconut milk expeller xii) Manually operated coconut milk extracting machine xiii) Safety attachment to paddle type coconut climbing device xiv) Shell fired copra dryer xv) Snowball tender nut machine xvi) Tender nut punch and cutter xvii) Virgin coconut oil cooker (Biogas/ LPG)
8.	Pests and management	i) Coreid bug ii) Eriophyid mite iii) Leaf eating caterpillar iv) Red palm weevil v) Rhinoceros beetle vi) Rodents vii) Slug caterpillars viii) White grub

Features of e- kalpa

- Cloud based Android mobile application
- Accessible both in offline and online modes
- Available free of cost from Google Play store
- Multilingual
- Interactive application (with scientists)
- Real time reporting of field problems and timely advisories
- Handy tool for farmers, farmer producers organizations, extension officials and other stakeholders

Components of e- kalpa

Language settings: You can select any of the language of your choice from the available language options and get needed information. You may also look into other languages since addition of technology snippets are in progress.

Knowledge base: In knowledge base, details are available for Coconut, Arecanut and Cocoa. When you touch the option on Coconut, technology details are available in Table :1:

Likewise information/technology snippets are

also available for Arecanut and Cocoa along with color photographs for easy access and utilization.

Crop information component: As per the feedback and need expressed by the users of e-kalpa for brief information capsules on inter and mixed crops, the component of 'Crop information' was made available. This attains importance since coconut is cultivated mostly as homestead farming system. The crop information contains spacing, seed rate, season of planting, quantity of farm yard manure/ compost and other fertilizers to be applied for the crop. The information for the following crops are available from crop information of e kalpa.

Beverage crops	Arecanut, Beetle Nut, Cocoa
Cereals and millets	Paddy, Ragi/ Finger Millet
Cool season vegetables	Beetroot, Cabbage, Carrot, Cauliflower, Onion, Palak
Cucurbitaceous vegetable	Ash Gourd, Bitter Gourd, Bottle Gourd, Cucumber, Oriental Pickling Lemon, Pumpkin, Ridge Gourd, Snake Gourd, Watermelon
Flower crops	Jasmine, Marigold
Fodder crops	Desmanthus, Fodder Grass, Fodder Maize, Fodder Sorghum
Fruit crops	Banana, Jack Fruit, Mango, Papaya, Pineapple, Rambutan
Oil seed crops	Coconut, Ground Nut, Sesame
Other vegetables	Amaranthus, Clove Beans, Dolichos Beans, Okra
Pulse crops	Cow Pea, French Beans, Horse Gram
Solanaceous vegetables	Brinjal, Chilli, Tomato
Spice crops	Black Pepper, Ginger, Nutmeg, Turmeric
Tuber crops	Amorphophallus, Chinese Potato, Colocasia, Greater Yam, Lesser Yam, Sweet Potato, Tapioca

This feature enables farmers or extension officials or any other concerned stakeholders the basic information on 70 crops in the system with a gentle touch on the mobile phone screen.

Input Calculator

For fertilizer application in a coconut garden, the farmer has to be aware of the age of the palm and the bearing nature for calculating the total fertilizers required for his coconut plot. In e kalpa the 'Input Calculator' provides the required quantity of organic manure, Lime/ Dolomite, Urea, Rajphos, Muriate of Potash and cowpea for young plants up to one year of planting, one year after planting, 2 years after planting and 3 years and onwards. In the opening

window the farmer has to enter the number of palms in each category in his garden and touch the next button. He will get a detailed report specifying the total quantity of fertilizers for each category of palms in his plot. The points to remember for the integrated nutrient management for the coconut palms on which schedule, frequency are also available in the input calculator.

Online features in e-kalpa - The facilities available in the online mode are as follows.

Real time reporting and facilitation of field problems of coconut farmers:

Facilities for real time reporting of field problems in the coconut plots itself are available in e- kalpa. For problem diagnosis and advisories from ICAR -CPCRI, farmers can use e- kalpa in a simple format. When you open online facilities of e- kalpa, you can see the component 'Farmer support'. When you touch this icon a window for reporting the field issues will appear. The farmer can take the picture or video from his field itself and can upload them. Touching the tick mark, it will reach CPCRI within seconds. The farmer could receive the response and advisories as early as possible.

Handy Tool for Coconut Producers Society (CPS) and Extension Officials:

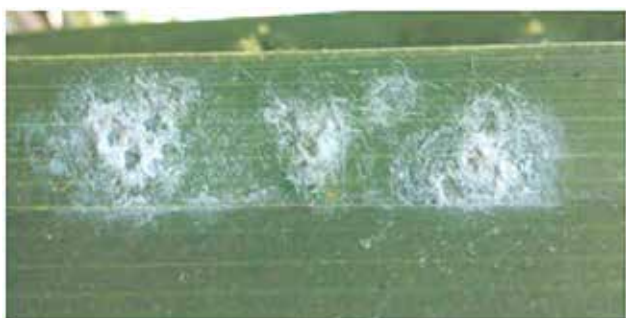
More than 9000 Coconut Producing Societies (CPS) have been registered under Coconut Development Board, clustering the small and marginal coconut farmers. One of the primary goals of the CPS is utilizing scientific technologies involving coconut farmers to improve their production, processing and marketing process as a group. e-kalpa could be used for outreaching the farmers with technologies and information at their fingertips, right in their field.

The technology snippets and the information furnished in the mobile application of ICAR-CPCRI is the collation of the research output and outcome from all the divisions of the institute, over the years in a single platform. Information and technologies are also important as production factors in farming. Information Communication Technologies (ICT) enables extension and research organizations to reach the society economically faster and ensuring responsibility. Hence the coconut farmers are requested to utilize this simple mobile application for improving their farm productivity through knowledge application, since farming is time critical and information intensive. ■

[Link address of e-kalpa: https://goo.gl/b3GTk0](https://goo.gl/b3GTk0)

Occurrence of invasive Bondar's Nesting Whitefly on coconut in Kerala

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ICAR-CPCRI, Regional Station, Kayamkulam – 690 533, Kerala, India.



Bondar's nesting whitefly colonies on coconut leaflet



Stalked eggs, crawlers and flat nymphs



BNW on woolly wax nests



Adult BNW with X-shaped oblique grey bands on wings

Whiteflies are sap feeding sucking bugs resembling tiny “moths” that inflict direct feeding injury on plants and serve as vectors of plant diseases or produce significant quantum of honeydew leading to deposits of sooty mould on plant surface interfering with photosynthetic efficiency. Whiteflies are emerging as a major threat in crop production mainly attributed to climate change. More than 440 species of whiteflies from 63 genera are known from India attacking 320 plant species including coconut. In coconut, three species of whiteflies viz., arecanut whitefly (*Aleurocanthus arecae*), spiralling whitefly

(*Aleurodicus dispersus*) and rugose spiralling whitefly (*Aleurodicus rugioperculatus*) have been reported so far (Chandrika Mohan *et al.*, 2017). Among the whiteflies reported on coconut, the rugose spiralling whitefly colonized in severe proportion and the impact was higher on palms in terms of sooty mould deposits especially on Chowghat Orange Dwarf variety.

Rugose spiralling whitefly is considered to be introduced from Florida (USA) into Pollachi (Tamil Nadu) and Palakkad (Kerala) during 2016. This pest could establish in all coconut growing tracts of South

India and is recently reported from North eastern state of Assam as well (Chandrika Mohan *et al.*, 2018). Pesticide holiday approach advocated by ICAR-CPCRI in synergy with conservation biological control using the aphelinid parasitoid, *Encarsia guadeloupa* and *in situ* preservation of sooty mould scavenger beetle, *Leiochrinus nilgirianus* could successfully reduce the invasive potential of this non-native pest (Josephraj Kumar *et al.*, 2018).

In this context and exactly two years after the appearance of the rugose spiralling whitefly on coconut in our country, we came across a new species of whitefly feeding on the lower surface of palm leaflets. This new whitefly is very small (< 1.0 mm) and has conspicuous X-shaped oblique grey bands on the wings. Nymphs and adults make nesting chambers of woolly wax resembling bird's nest and the adult bugs confine on these nests for egg laying. Presence of woolly wax nests on abaxial palm leaflets is one of the features for pest identification. Adult whitefly lays stalked eggs devoid of woolly wax coating and the nymphs are absolutely flat with well developed fibreglass like projections from the dorsum. Puparium has one cephalic compound pore, six abdominal compound pores and out of which two are reduced. These compound pores possess flower-petal like facets. Male genitalia are very unique with terminal short apicolateral process. Furthermore, molecular characterization of this pest (GenBank Accession No. MK343480) shared 100% similarity with the nucleotide sequences of Bondar's nesting whitefly from Florida, USA. Based on these morphological features and molecular characterization, the new whitefly pest is identified as Bondar's nesting whitefly (BNW), *Paraleyrodes bondari* Peracchi, which is reported in the Indian subcontinent for the first time on coconut palms. Excessive de-sapping by the pest produces honey dew which result in sooty mould deposits on plant surface. BNW incidence was noted in most coconut varieties with nest colonies exceeding 25 per leaflet. Cool minimum temperature (<21°C) and sunny day temperature (>32°C) similar to neotropics might

Retirement



Smt. K.G. Umadevi, employee of Coconut Development Board retired from the services of the Board on 31st December 2018 on superannuation. She joined the Board in 1989 and has served the Board for around 30 years.

have favoured the establishment of the pest in this region.

BNW has more than 25 susceptible host plants which include banana, avocado, citrus, cassava, custard apple, ornamental Ficus spp. etc. Some grubs of coccinellid beetles were noticed around the BNW colony, however, no parasitoid was recorded from our observation. As with all whiteflies, BNW is of neotropical origin described from citrus for the first time. It was also reported from Florida, USA and from other Pacific regions. Co-existence of *P. bondari* and *Aleurodicus rugioperculatus* on coconut palms infer simultaneous arrival of both these pests from New World region. Polyphagous nature of the non-native BNW warrants stringent quarantine protocols during exchange of planting materials so as to avoid such bio-invasion in future. With the sightedness of coccinellid predators, jet water spray and pesticide holiday approach is advocated to manage this new pest. Farmers need not panic as the pest is not reported to cause economic damage in any of the crops from other countries. Strict quarantine should be enforced in the transport of planting materials to reduce such bio-invasion. ■

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Collection and utilization of coconut germplasm in different regions of India

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Introduction

Coconut (*Cocos nucifera* L.) is one of the most important tropical crops in the world, and is grown in more than 93 countries. Bestowed with most congenial agro climatic conditions, diverse soil types and abundant water resources, coconut cultivation in India is making inroads and the area under the crop attained more or less a linear growth pattern. In India there is distinct difference in pattern of distribution of coconut cultivation

The four southern states; Kerala, Karnataka, Tamil Nadu and Andhra Pradesh are the main coconut growing areas in the country which together account for 90% of area and 93 % in production. In other areas, coconut is not contiguously grown. Major portion of coconut comes from the West Coast comprising of Kerala, Karnataka and Maharashtra followed by the East Coast of Andhra Pradesh, Orissa, Tamil Nadu and Pondicherry. In non-traditional states like Bihar, Chhattisgarh, Gujarat, West Bengal, Assam, Tripura, Nagaland, Manipur, Meghalaya, Arunachal Pradesh and Islands of Andaman & Nicobar and Lakshadweep also coconut cultivation has gained momentum.

Genetic resources in coconut

Coconut genetic resources have been traditionally collected and conserved in major coconut producing countries with the objective of using these to improve the genetic makeup of their existing cultivars. Selected germplasm are generally used as: planting material to improve the coconut productivity in the country or a region, test material to determine the phenotypic and genotypic characters of value and, population base for breeding superior hybrids/ varieties.



Kalpa Samrudhi

Based on their origin, coconut germplasms could be categorized into: traditional varieties or landraces, as exotic varieties introduced into the country, or as modern varieties or hybrids resulting from a national breeding effort. Most coconut producing countries have a mixed population of landraces and introduced hybrids/varieties. There are continuing efforts to further improve cultivars through mass selection and hybridization.

As breeding material, the coconut germplasm are generally grouped according to their growth habit. In addition, the differences in their mating behaviour give the breeders flexibility in designing various breeding schemes to achieve their desired coconut ideotypes. The STANTECH manual described the following major classification of coconut:

1. Tall palms, sometimes referred to as var. typical (Nar.), are essentially cross-pollinating and therefore considered to be heterozygous. They are slow maturing and flower 6-10 years after planting, and can grow to a height of 20-30 m. They have an average economic life of 60-70 years.

2. Dwarf palms, sometimes referred to as var. nana (Griff.), are normally self-pollinating and therefore considered to be homozygous. They are believed to be mutants from Tall types with short stature, 8-10 m when 20 years old. They begin bearing from the third year sometimes at less than 1 m stem height but have a short productive life of 30-40 years.

There are also rare 'intermediate types' which do not express the phenotype normally associated with either the Talls or the Dwarfs. Natural crosses between Tall and Dwarfs occur sporadically in traditional populations. In some instances, such open-pollinated hybrids may become fixed as 'semi-Talls', which have the same mating behaviour as Dwarfs but grow faster. In the South Pacific, there is also a Niu Leka Dwarf, which has all the characteristics of a Tall type coconut, except for its short stature. These intermediate types have a good potential in broadening the genetic base of the breeding population but their parental value has yet to be fully evaluated.

Coconut cultivars in India

The tall cultivar is extensively grown throughout India, while the dwarf is grown mainly for parent material in hybrid seed production and for tender coconuts. The tall cultivar generally grown along the west coast is called West Coast Tall, and the cultivar grown along the east coast is called East Coast Tall.



The local talls such as Tiptur Tall, Lakshadweep Ordinary, Goan Tall and Sakhigopal also grown in both the coast. Chowghat Dwarf Orange, Chowghat Dwarf Green, Malayan Yellow Dwarf and Malayan Orange Dwarf are some of the dwarf cultivars grown in India. Gangabondam, a local semi dwarf variety from Andhra Pradesh is also cultivated in selected areas.

The genetic resources in coconut are widely exploited through selection and hybridization for a number of desirable traits and have resulted in the development of many varieties in India. Breeding efforts are mostly confined to conventional approaches such as mass selection and hybridization, besides attempts to use individual palm selection for novel traits. Its perennial nature, heterozygosity, long juvenile phase and lack of technologies for mass propagation of palms with targeted traits are the challenges in breeding efforts. The research on coconut in India is being carried out by the institutions under the Indian Council of Agricultural Research (CPCRI, Kasaragod and AICRP on Palms) and the State Agricultural Universities located in different coconut growing states.

Central Plantation Crops Research Institute, Kasaragod

The Central Plantation Crops Research Institute (CPCRI) hosts the International Coconut Genebank for South Asia (ICG-SA). The field genebank in Kidu Farm, Karnataka, which is the ICG-SA field genebank. CPCRI maintains the world's largest assemblage of germplasm collection of coconut (comprising 401 accessions: 269 indigenous and 132 exotic). The exotic collections are from 28 countries of South Asia, South-East Asia, Africa, Caribbean Islands, Indian Ocean Islands and Pacific Ocean Islands are maintained by undertaking the planting and maintenance of the field genebank. The National

Bureau of Plant Genetic Resources (NBPGR), New Delhi, collaborates with CPCRI on cryopreservation activities. Varieties released by CPCRI, Kasaragod is listed below:

- Released Fourteen improved varieties of coconut (Chandra Kalpa, Kera Chandra, Chowghat Orange Dwarf, Kalpa Pratibha, KalpaDhenu, Kalpa Mitra, Kalparaksha, Kalpasree, Kalpatharu, Kalpa Jyothi, Kalpa Surya and Kalpa Haritha, Kalpa Sresht and Kalpa Shatabdi).
- Released Five high yielding hybrids of coconut - Chandra Sankara, Kera Sankara, Chandra Laksha, Kalpa Samrudhi and Kalpa Sankara.
- Dwarf varieties viz., Chowghat Orange Dwarf, Kalpa Jyothi, Kalpa Surya were released exclusively for tender coconut.
- Kalpa Pratibha, Kalpa Haritha, Kalpa Samrudhi, Chandra Sankara, Kalparaksha and Kalpasree were released as dual purpose varieties suitable for copra and tender nuts
- Chandra Kalpa, Kalpa Mitra, Kalpa Dhenu, Kalpa Pratibha Kalpatharu and Kalpa Samrudhi are relatively tolerant to drought.

All India Coordinated Research Project on Palms (AICRPP)

All India Coordinated Research Project on Palms (AICRPP), has been an important contributor to the region's specific coconut research and development effort. The concept of AICRP on Palms came into existence in 1972 to carry out the location specific research, and to address the region specific problems. At present, the project is implemented in 30 centers with its headquarters at Kasaragod; 15 centers are conducting research on coconut, eight on oil palm, four on arecanut, four on palmyrah and seven on cocoa. The coordinating centers are located in 13 states and one union territory covering 13 State Agricultural University's, one Central Agricultural University and four ICAR institutes.

Germplasm collection and conservation plays a prime role in crop breeding as the very objective of the activity is to preserve the genetic diversity of a particular plant or genetic stock for its use at any time in future. Research efforts were undertaken to conserve and evaluate coconut germplasms; collect, conserve and evaluate local germplasm collections and evaluate elite genotypes from germplasms in multi-location trials.

A total of 112 ecotypes of coconut have been

collected from Assam, Chhattisgarh, Odisha, West Bengal, Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra for desired traits and conserved for further evaluation and deposited in National Active Germplasm Site, CPCRI, Kasaragod.

Table 1. Genetic resources maintained at AICRP on Palms centres:		
Name of the centre	Number of accessions maintained	Number registered with NBPGR (IC Nos.)
Aliyarnagar	12	610368-79
Ambajipeta	13	610306-18
Arsikere	20	610333-52
Bhubaneshwar	11	612457-67
Jagdapur	10	610323-32
Kahikuchi	15	610353-67
Mondouri	10	612447-56
Navsari	4	610319-22
Ratnagiri	12	599111-16 599994-9
Veppankulam	7	599263-69
Varieties developed by the AICRP on Palms centres		

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 these varieties/hybrids are presented in table 2.

Conclusion

Considering the substantial number of coconut accessions conserved *in situ* and *ex situ* worldwide, the available genetic variability for breeding manipulation is tremendous but hardly used. Current breeding programmes are using very few of these available germplasm. The main problem appears to be the lack of complete characterization (morphological, physiological and molecular) of most of the conserved germplasm which would give an indication of their potential as breeding materials. Ultimately, the germplasm collection and utilization programme should be able to significantly increase the choice of hybrid development, by maximizing the use of available genetic resources for breeding purposes and improving the quality of the planting materials for farmers. ■

Table 2. Varieties/hybrids released from AICRP on palms through selection and hybridization from germplasms

Variety	Year of Release	Breeding Method	Parents	Important traits	Institute/ University
Pratap	1987	Selection	Banawali	Tall palm with semicircular canopy and green colour round shaped nuts. Commence flowering 7-8 years after planting 140 to 145: nuts/palm/year, Copra yield: 145 g/nut, 3.5. t/ha and Oil content of 68 %	Dr.BSKKV, Maharashtra
Godavari Ganga	1991	Hybruduation	ECT x GBGD	The palm comes to bearing in four years after planting. Has the potential of 140 nuts/palm/year. Copra content 150 g/nut and out turn of 2.79 t/ha.	APAU, Andhra Pradesh
Kamrupa	2001	Selection	Assam Green Tall	Gives an average yield of 17600 nuts/ha/year 101 nuts/palm/year. This cultivar yields 16.3 kg copra/palm/year leading to a copra yield of 2.86 tonnes/ha and tender nut water of 253ml. Nut water contains 5.16g/100 ml of total sugar and 2294 ppm of potassium.	AAU, Assam
ALR (CN) 1	2002	Selection	Arasampatti local	Nut characters: Small to medium sized , Oblong shaped , Green coloured , Average nut yield : 126 nuts / palm / year; Copra content : 131 g / nut; Copra yield : 16.5 kg / palm / year; Oil content : 66.5 %	TNAU, Tamil Nadu
Kalyani Coconut -1	2007	Selection	Jamaican Tall	It gives 14066 nuts/ha/year with an average yield 80 nuts/palm/year. The copra content is 154 g/nut with copra yield of 12.3 kg/palm/year. Tender nut quality of the variety is good with 350 ml of water, 4.9 % of total sugar content and high potassium (2347 ppm) content.	BCKV, West Bengal
Gauthami Ganga	2007	Selection	Gangabondam,	average nut yield of 80 to 90 nuts/palm/year. Dwarf palm with semi circular canopy with oblong shaped green colour fruits. Yields 12813 nuts/ha/year with copra content of 156.7g/nut and an oil content of 68%.	ANGRAU, Andhra Pradesh
Kera Keralam	2007	selection	West Coast Tall	It is found to be promising and adaptive to wide ranging cultivation zones; comes to flowering in 58 months. Yields 147 nuts/palm/year with irrigation. In east coast region of Tamil Nadu, it recorded higher nut yield by 19 to 48 % over the previously released varieties.	TNAU, Tamil Nadu
Konkan Bhatye Coconut Hybrid -1	2007	Hybrid	GBGD x ECT	Tall palm with semi- circular bearing at 66 months with green colour oval shaped fruit. This hybrid yields 122 nuts/palm/year (20300 nuts/ha/ year) with copra yield of 22.08 kg/palm/year It is resistance to stem bleeding diseases and moderately resistance to leaf blight and bud rot.	Dr.BSKKV, Maharashtra
Kera Bastar	2007	Selection	Fiji Tall	The nut yield ranges from 110 to 117 nuts/palm/year with a copra yield of 2.5 to 3.1 tonnes/ha. Widely adapted to different agro- climatic zones. Quantity of tender nut water is 332ml and total sugar content in tender nut is 6.2g/100 ml.	IGKV, Chhattisgarh
Kalpa Dhenu	2007	Selection	IND 006 (AGT)	It is a regular bearer, relatively tolerant to drought. The palms are tall, robust and bear large, green nuts. It commences flowering in 67 months after planting. The quantity of tender nut water is 290 ml/nut.. It produces an average yield of 15012 nuts/ha, copra yield of 37 q/ha and oil yield of 24 q/ha.	CPCRI, Kasaragod
Kalpa Prathiba	2007	Selection	IND 016 (CCT)	It is suitable for tender nut and copra. The variety is a regular bearer, relatively tolerant to drought. The nuts are large, round in shape and predominantly green in colour. The quantity of tender nut water is 448 ml/ nut. It produces an average yield 15874 nuts/ha, copra yield of 41 q/ha and oil yield of 27 q/ha.	CPCRI, Kasaragod
Kalpa Mitra	2007	Selection	IND 022 (JVT)	It is a regular bearer, relatively tolerant to drought and produces large, yellowish green, oval shaped nuts. The variety is suited for west coast region of the country and West Bengal. Suitable for ball copra. The quantity of tender nut water is 495 ml. It produces an average yield of 13973 nuts/ ha, copra yield of 34 q/ha and oil yield of 22 q/ ha.	CPCRI, Kasaragod
Kalpatharu	2009	Selection	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. Recommended for rain fed and irrigated regions of Karnataka, Tamil Nadu and Kerala states.	UHS, Karnataka
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%) has been recommended for release for the region by AICRP on Palms, Kahikuchi centre in collaboration with CPCRI, Kasaragod. The hybrid is semi-tall, precocious.	CPCRI, Kasaragod

Kalpa Jyothi	2012	Selection	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.	CPCRI, Kasaragod
Kalpa Surya	2012	Selection	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.	CPCRI, Kasaragod
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.	CPCRI, Kasaragod
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).	Dr. YSRHU, 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).	Dr. YSRHU, 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.	UHS, Karnataka
VPM 5	2015	Hybrid	LCOT x CCNT	The mean nut yield of the hybrid during the stabilized bearing period was 161 nuts/palm/year, which is 62.6 and 43.8 and higher than ECT and VHC 1 respectively. It has a 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).	TNAU, Tamil Nadu

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Intercropping of fruits and vegetable crops in coconut garden in Gujarat

P. P. Bhalerao* and H. P. Maheswarappa**

AICRP (PALMS), ASPEE College of Horticulture and Forestry, Navsari Agricultural University,
** Project Coordinator (Palms), ICAR-CPCRI, Kasaragod, Kerala

Coconut is one of the important plantation crops of Gujarat state particularly in coastal areas. State enjoys 1600 kms of coastal belt (the highest for any state in the country) most suitable for coconut plantation. About 60 per cent of the area and production of coconut comes from the undivided coastal districts of Junagadh, Bhavnagar, Valsad, Gir Somnath and Devbhumi Dwarka. The traditional area is predominantly of tall varieties of coconut which thrive for more than 80 years. Coconut is considered as the cash crop of more than 5 lakh people residing in the coastal belt. In the state, coconut farmers are facing problems like fragmented holding, scattered production, homestead nature of cultivation, lack of skilled manpower, incidence of pest and diseases, lack of adoption of scientific cultivation practices, lack of appropriate mechanization for harvesting and small scale processing and lack of awareness about improved technologies.

Coconut gardens offer excellent opportunities to exploit the interspace potential for maximizing returns per unit area. Coconut based cropping systems involving cultivation of compatible crops in the interspaces of coconut and integration with other enterprises like dairying, fishery, piggery unit offer considerable scope for increasing production and productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour. Under such a cropping system, all the management practices and component production systems should be able to maintain high productivity, profitability and sustainability of the existing coconut palms to maximize economic yield of the farm. Sustainability is the main objective of farming system, where the production process is



optimized through efficient utilization of the inputs in safeguarding the environment. Fruit, spices, tuber and forage crops are important crops that can be grown as intercrop in coconut gardens in the South Gujarat region. Studies conducted at AICRP (Palms), Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari and other research institutions of the country have unambiguously proved the technical feasibility and economic viability of intercropping as compared to the monocropping of coconut. Many farmers also have adopted the technology and realized the profitability and sustainability in the coconut garden. The success story of a farmer who could integrate fruit crop as well as vegetables in coconut garden and achieved economic benefits is briefed here.

Mr. Harshad Raghunand Bhandari is a young enterprising farmer of the village Nargol from Umergaon tahsil of Valsad district of Gujarat state. He is a graduate and actively participates in horticulture exhibitions, training programmes etc. and also encourage to other farmers for cultivation of coconut by adopting coconut based cropping system. He has built a good rapport with scientists



and is continuously in contact with the AICRP (Palms), NAU, Navsari and state horticulture department of Gujarat state. He started coconut cultivation with his two brothers during 1998 in 17 ha area and presently his garden is with palms of various ages and different varieties like WCT, COD and MGD. He adopted the coconut based integrated cropping system model in his farm after visiting AICRP Palms centre at Navsari and started cultivating different vegetable crops (brinjal, okra, tomato, cucumber and cowpea) and fruit crops (banana) as an intercrop under young as well as old coconut garden in a systematic manner for the last three years in a one hectare garden. For all the crops, he adopted recommended package of practices with regard to nutrient management

and water management. For supplying the required nutrients, organic manures viz., FYM/ poultry manure/goat manures were used. The biomass from the crops is being recycled in the garden in the form of mulching and converting it into suitable vermicompost. He harvests the nuts for tendernut purpose, wherein the vendor himself harvests the nuts and gives the prevailing market price as there is growing demand for tendernut in the state. By his experience, he has realised increase in the yield of coconut under intercropped garden compared to monocrop apart from getting the additional income from the intercrops. The economics (average of 3 yrs) of the system indicated that, the variable cost of production involved to maintain one ha of the system was around Rs. 1,15,000/- to Rs. 1,20,000/- per year and the average net return realized from all the crops was to the tune of Rs. 2.85 lakhs to 3.45 lakhs/ha per year depending upon the market price of the crops. Thus, from his experience it was realized that, cropping system with banana and vegetables in coconut is highly profitable and remunerative over a period of time in the South region of Gujarat.

Contact address of the farmer: Mr. Harshad Raghunand Bhandari Nargol village, mergaon tahsil, Valsad (Dt), Gujarat. Mobile: 9879142770

Cabinet approves hike in MSP for Copra for 2019 season



The Cabinet Committee on Economic Affairs, chaired by the Prime Minister of India, Shri Narendra Modi, has given its approval for increase in the Minimum Support Price (MSP) for Fair Average Quality (FAQ) of Milling Copra Rs.9521/- per quintal for 2019 season from Rs. 7511/-per quintal in 2018 and the MSP of Ball Copra has been increased to Rs.9920/- per quintal for 2019 season from Rs. 7750/- per quintal in 2018.

The MSP of Copra is expected to ensure appropriate minimum prices to the farmers and step up investment in coconut cultivation and thereby production and productivity in the country. The approval is based on the recommendations of Commission for Agricultural Costs and Prices (CACP). CACP, an expert body, which takes into account the cost of production, trends in the domestic and international prices of edible oils, overall demand and supply of copra and coconut oil, cost of processing of copra into coconut oil and the likely impact of the recommended MSPs on consumers, while recommending the MSPs.

The National Agricultural Cooperative Marketing Federation of India Limited (NAFED) and National Cooperative Consumer Federation of India Limited(NCCF) would continue to act as Central Nodal Agencies to undertake price support operations at the Minimum Support Prices in the coconut growing states.

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Workshop on Scientific Coconut Cultivation

A Coconut Cultivation Development Meet and District Level Workshop on Scientific Coconut Cultivation Technology held at Krishi Vigyan Kendra, Motihari.

Coconut Development Board, Farmers' Training centre-cum- Regional Office, Patna conducted a Coconut Cultivation Development Meet and District Level Workshop on Scientific Coconut Cultivation Technology on 24th December 2018 at Krishi Vigyan Kendra, Piprakothi, Motihari, East Champaran District. The meet was inaugurated by Honourable Union Minister of Agriculture and Farmers' Welfare Shri Radha Mohan Singh. Hon'ble Minister in his inaugural address appreciated the activities of the Board being implemented for the integrated development of coconut farming and industry in the state. Dr. Amiya Debnath, Deputy Director (Dev), Coconut Development Board, Regional Office, Patna welcomed the Minister. Shri Pramod Kumar, Honourable Minister for Tourism, Bihar, Shri Sachindra Prasad, MLA, Kalyanpur, Shri Shyam Babu, MLA, Pipra Kothi, Dr. R.C. Srivastava, Vice Chancellor, Rajendra Agricultural University, Pusa, Samastipur, Bihar, Dr. B P Bhatt, Director, ICAR, Regional Office East, Patna, Dr. B.L Saraswat, Executive Director, National HoneyBee Board, Krishi Bhavan, New Delhi, Mission Director, National Bamboo Mission, Guwahati, District Horticulture Officer, Motihari, District Agriculture Officer, Shri Sanjiv Kumar Singh, Member, Coconut Development Board and Shri Ravindra Kumar, Technical Officer, Coconut Development Board, Regional Office, Patna were present on the occasion.

Dr. Amiya Debnath, Deputy Director (Dev), Coconut Development Board, Regional Office,



Patna briefed on the schemes of the Board like area expansion programme, Friends of Coconut Tree training, coconut handicraft training and other schemes and also on different coconut products and byproducts like coconut oil, coconut milk powder, coconut jam, coconut water, biscuit, virgin coconut oil and capsule. He spoke about the various aspects of coconut cultivation and marketing.

Shri. Ravindra Kumar, Technical Officer, Coconut Development Board, Regional Office, Patna made a presentation on scientific coconut cultivation practices in which detailed information on coconut cultivation, disease and pest management were focussed. Income generation from coconut cultivation was also.

Shri Sanjiv Kumar Singh, Member, Coconut Development Board shared his experience in coconut cultivation and briefed about promotion of inter-cropping and mixed cropping with coconut so that income of the farmers can be enhanced.

CAU, Manipur to develop a perspective plan for coconut in the North East Region

Dr. Raju Narayana Swamy, IAS, Chairman, Coconut Development Board visited Central Agricultural University (CAU), Imphal, Manipur on 2nd January 2019 and had interaction with Dr. Premjit Singh, Vice Chancellor and scientists of The University. The team discussed on developing a perspective plan for coconut in the North Eastern Region.

The Chairman, CDB gave a brief introduction about the Board and on the value added products of coconut. He further briefed on the need for developing a perspective plan for the comprehensive development of coconut cultivation and value addition in the North Eastern Region. He requested CAU to develop a roadmap for the same. The



Chairman highlighted the Board's intervention in the field of application of artificial intelligence in mitigation of crops loss due to stress and pest and disease, in developing climbing robots etc. Value addition is the key to income generation and hoped that North Eastern India need to become the hub of coconut cultivation. The Chairman further requested the scientists to develop a perspective plan for coconut in the model of a Coconut Park which can undertake all activities of coconut cultivation and value addition.

Dr. S. Basanta Singh, Director of Instruction informed that, there is good scope for Area Expansion Programme in Kolassip, Mamita and Lonklai – border of Basigad area of Mizoram. Around 2000 ha. can be mobilized in this area. Dr. Ratan Kumar Saha, Director of Extension Education informed that, Tripura is having great potential for coconut area expansion programme. Nearly six districts of Tripura are having huge potential to expand the area under coconut. Pasigar area in Arunachal Pradesh bordering with Assam can be focused on area expansion of coconut. Tura Hills in Arunachal Pradesh and Saro Hills in Megalaya border are suitable for coconut cultivation. Manipur Plantation Crops Corporation can be approached for the development of coconut in Manipur. Tengnoupal District in Manipur is also suitable for coconut cultivation. Nearly 10000 Ha. in the Tiger Hills near Myanmar border can be converted into coconut plantation which is an alternate crop for income generation for this belt. Project Tiger Hills can be started immediately. Similarly more project can be developed for coconut cultivation. Horticulture Department can be involved in this programme. In Nagaland, Dimapur and Zaloki areas are suitable



for coconut cultivation. The Chairman intimated that, Project Tiger Hills and homestead planting of coconut can be thought of immediately.

Dr. S. Basanta Singh, Director of Instruction, Dr. C.A. Srinivasamurthy, Director of Research, Dr. Ratan Kumar Saha, Director of Extension Education, Dr.Y. Ranjana Devi, Deputy Director of Instruction, Dr. Th. Robindro Singh, Deputy Director of Research, Dr. Angad Prasad, Deputy Director of Extension Education, Dr. Y. Bedajit Singh, Deputy Director Instruction and Dr. A.K. Mishra, Deputy Director of Research of CAU, Shri Lungher Obed, Director, CDB, RO, Guwahati, ShriA. Jeyapandi, Deputy Director (Mktg.), CDB, RO, Chennai and Smt. Jayashree, Development Officer, CDB, Kochi attended the meeting.

CAU, Imphal occupies the 13th position in the National ranking of Agricultural Universities of India and is having 13 colleges spread over seven states of North Eastern Region.

National Level Conference on Virgin Coconut Oil

Coconut Development Board in association with CSIR-Central Food Technological Research Institute (CFTRI), Mysuru conducted one day National Conference on Virgin Coconut Oil (VCO) on 26th December 2018 at CFTRI Mysuru.

In the inaugural session, Dr. Raju Narayana Swamy, IAS, Chairman, Coconut Development Board (CDB) spoke on the need for doubling the farmers income by 2022 as envisaged by the present government with focusing on technology, value addition and marketing. He emphasized on achieving higher value realization for minimum of 25 coconut products. He told that virgin coconut oil has got maximum attention and called upon the policy makers to further expand its reach thereby benefitting farming community to enhance their income. He complimented, CSIR-CFTRI for doing the commendable work in developing coconut based technologies that support the CDB endeavour to add value on a greater scale. The Chairman stressed that, CDB is working with Indian Institute of Science to develop artificial intelligence using drones to assess the health of coconut trees. This will help farmers to take timely action to protect the valuable trees and products in time. These kinds of technologies are already used in Srilanka. He highlighted that, due to paucity of labourers, the Board is contemplating to develop Robot to pluck coconut fruits. To assist the value addition chain of coconut products, CDB has signed Memorandum of Understanding with Indian Institute of Food Processing, Thanjavur for developing Coconut Ice Cream Vending Machine.

The Chairman appreciated CSIR-CFTRI for organizing the event in the Institute for interacting with VCO manufacturers, coconut product traders and machine manufacturers which will help the future R&D on the lines of conference outcome.

Director CSIR-CFTRI endorsed the remarks of Chairman CDB. He informed that, CSIR-CFTRI will take up coconut product development with special



emphasis on coconut milk based technologies which will benefit farming community towards enhancing income. The Conference had two technical sessions comprising of a plenary talk and research paper presentation by eminent speakers.

The first technical session was chaired by Dr. Navin K. Rastogi, Chief Scientist & Head, Food Engineering Department, CSIR-CFTRI, Mysore and Co-Chaired by Dr. S.V. Ramesh, Sr. Scientist, Department of Biochemistry, CPCRI.

Dr. P. Rethinam, Former Executive Director, APCC & former Chairman Coconut Development Board in his plenary talk spoke on the “Current Scenario and Future Prospects of Virgin Coconut Oil manufacturing: Indian Prospective”. He emphasized the importance of VCO and indicated that VCO contains Medium Chain Triglycerides (MCT) with high content of Lauric acid (more than 46.8%), which are having properties of developing immunity. He further spoke on the different methods of VCO manufacturing. He opined that VCO is expected to experience high demand from consumers who are high health conscious as



well as among the aging population. He further told that if we can fulfill the requirement of importers and consumers, we can have a steady market.

Further in the session on general aspects of VCO manufacturing, Shri Aravazhi, Deputy Director, CDB and Shri. Sreekumar Poduval, Processing Engineer, CDB spoke on the importance of VCO and explained the different methods for the preparation of VCO.

In the session on Virgin coconut oil manufacturing and quality aspects, Dr. S.V. Ramesh, CPCRI, Kasaragod spoke on the quality of VCO which profoundly differs from the traditionally produced coconut oil in terms of quality attributes. VCO is reported to be rich in polyphenolic compounds, tocopherols and phytosterols. Major polyphenolic compounds identified in VCO were protocatechuic, vanillic, caffeic, syringic, ferulic and p-coumaric acids. He also briefed the various process of VCO manufacturing developed at ICAR-CPCRI and the quality profile of resultant oils.

In the session on value addition and processing technologies for integrated coconut processing plant, Mr. K. Rajarathinam, Essar Engineers, Coimbatore spoke on the range of equipment for integrated coconut processing plant for processing coconut husk based products, coconut shell based products as well as coconut meat and water based products. He also stressed on value addition and improved processing technologies and development of modernized equipment for producing desiccated coconut powder, coconut water concentrate, virgin coconut oil and coconut milk.

The first session concluded with a session on technologies of oils wherein Dr. S Yella Reddy, Rtd. Scientist, CSIR-CFTRI, Mysore spoke on the basics of

the technology of oils and importance of VCO.

The second session was chaired by Dr.G.Venkateswaran, Chief Scientist & Head, Microbiology & Fermentation Department, CSIR-CFTRI, Mysore and Co-Chaired by Dr.G.Suresh Kumar, Scientist, Department of Biochemistry, CSIR-CFTRI. The session started with plenary talk by Dr.K.S.M.SRaghavarao, Director, CSIR-CFTRI Mysore on Virgin Coconut Oil and other Functional Foods from Coconut. Dr. Raghavarao in his presentation emphasized the importance of VCO and how this research was initiated at CFTRI. He briefed on the health benefits of VCO and metabolism in human system. Dr. Rao informed that products such as desiccated coconut powder, spray-dried coconut milk powder and coconut dietary fiber are having medicinal value. Apart from these products, Dr. Rao also spoke on the importance of coconut lassi, matured coconut water in pouches, coconut jam, coconut jelly using addition of pectin and xanthan powder. He further explained about the membrane process for Cocolal (Coconut water) in tetra pack. Finally, Dr.Rao explained to entrepreneurs on how to make use of VCO and its by-products to get considerable revenue.

Further to the plenary talk, Dr. Sakina Khatoon, Scientist (Retd) Lipid Science Dept.CSIR-CFTRI spoke on Medium Chain Triglycerides (MCT) rich oil processing and benefits for food/nonfood applications: She stressed the importance of Medium Chain Triglycerides (MCT) rich oil with special emphasis on Coconut Oil and its health benefits. The applications of MCT in foods and nonfoods were also briefed.

Dr.R.Chethana, Sr. Tech.Officer, CSIR-CFTRI, Mysore spoke on value added technologies from coconut. She listed the technologies available with CFTRI for coconut and its products. The value added products such as desiccated coconut powder, coconut chutney (both wet & dry) coconut milk spray dried powder, coconut jelly & jam, tender coconut jam etc. were well explained in her presentation.

Dr.K.Ramalakshmi, Professor & Head, Food Technology Division, BIT, Satyamangalam, Erode spoke on processing and preservation of coconut sap(Neera). She briefed the process of extracting the coconut sap (Neera) from coconut trees by taking care of safety aspects. Clarification regarding the hygienic way of collecting neera from the farm yard to consumer was stressed and the importance of health benefits of neera was also explained.

Dr. Sanjit Kanjilal, Principal Scientist, CSIR-IICT, Hyderabad in her session on virgin coconut oil v/s coconut oil: physicochemical properties, spoke about the importance of edible oil and its fatty acid profiles and its health benefits. He also mentioned about the FSSAI's recent regulatory norms for certain blended oils.

A panel discussion was followed wherein Dr. Raghavarao Director, CSIR-CFTRI, Shri. Sathyendra Rao, Head, Technology Transfer and Business Development CSIR-CFTRI, Dr. Alok Srivatsava, Head, Food Safety & Analytical Quality Control Laboratory, CSIR-CFTRI, Dr. Rastogi NK, Head, Food Engineering, CSIR-CFTRI, Dr. Ramesh, Scientist, Central Plantation

Crops Research Institute, Dr. Sanjit Kanjilal, Principal Scientist, Indian Institute of Chemical Technology, Shri. Aravazhi, Deputy Director, Coconut Development Board, Shri. Sreekumar of Pranathmaka Ayurvedics Pvt Ltd Kerala, Shri. Parthiban of Keratech, Kerala and Dr. Venkatesh Murthy Head, Traditional Food Sensory Science, CSIR-CFTRI participated.

The conference was concluded with a vote of thanks by Dr. Giriappa K, TTBD, CSIR-CFTRI. Beneficiaries of VCO technologies from CSIR-CFTRI and other coconut product manufacturers, FPO members, machinery manufacturers, exporters and prospective entrepreneurs and officials took part in the conference. ■

CDB to join hands with NIPHM, to give training in coconut plant health management



Dr. Raju Narayana Swamy, IAS, Chairman, CDB visited NIPHM, Hyderabad on 18th January 2019 and discussed with the Heads of Divisions of NIPHM in developing a training curriculum for coconut farmers and officials of CDB in plant health management covering all aspects of coconut. Ms. G. Jayalekshmi I.A.S. Director General, NIPHM welcomed Chairman and briefed about the activities of the institute. Dr. Ch. Sreenivas Rao, Director (PMD), Dr. J. Alice R.P. Sujeetha, Director, (PBD), Dr. Om Prakash Sharma, Jt Director (A&AM), Dr. Vidhu K, Jt. Director (PHE), Ms. D. Chanchala Devi, Registrar and other officials attended the meeting.

Chairman, CDB briefed on the requirement of developing a curriculum for giving training to the technical staff of CDB by including all major developments in coconut sector. Developing a special training programme for the farmers of

NE states was also discussed. The importance of clubbing on farm production of bio control agents, bio pesticide formulations and production, intercropping practices, formation of FPOs; organic farming practices; control of rodents and invasive pests etc in the module for training was emphasized.

NIPHM will explore the possibility of organizing a training programme exclusively for the coconut farmers in the north eastern states and a national seminar of coconut and its value added products will be organized by CDB in association with NIPHM. A post graduate diploma program exclusively for the technical staff of CDB will be explored by NIPHM with focus on the coconut crop. It was also agreed to design a protocol for production of quality coconut seedlings in the DSP farms of CDB and also to focus on farmers training.

Coconut Handicraft training

A five days training programme on Coconut Handicrafts was organized at Coconut Development Board, Farmers Training Centre cum Regional Office, Patna from 22nd December 2018 to 27th December 2018. Shri Ashok Kumar Sinha, Deputy Director, Upedra Maharathi Shilp Anusandhan Sansthan, Patna and Dr.Amiya Debnath, Dy.Director, CDB, RO, Patna inaugurated the programme on 22nd December 2018 at Farmers Training Centre cum Regional Office, Patna. Shri Nikunj Bihari, Pranshu Coco, Craftsman and Master Trainer, Munger District gave training to the participants.

While addressing the gathering Shri Ashok Kumar Sinha, Deputy Director, Upedra Maharathi Shilp Anusandhan Sansthan, Patna said that his Institute is organizing various handicrafts training programmes in Bihar state. There is huge demand for handicraft items in our country as well as abroad. Training programmes on coconut handicrafts are conducted through Coconut Development Board. There is huge demand for handicrafts made out of coconut shell also. He said that all trainees should attend the training with full devotion so that in future they could take up this art as a profession and earn livelihood.

Dr.Amiya Debnath, Dy.Director said that the objective of organising this training programme at Farmers Training Centre cum Regional Office is that the local community may be benefitted with this and they could make this as a profession for their livelihood.

Shri. Nikunj Bihari, Master Trainer gave a brief description about the handicraft items made up of



coconut shell and the process of making handicrafts and imparted training to these trainees. He also shared information on various types of handicrafts made with coconut and the market price for these products.

15 trainees attended the programme. All the trainees displayed their handicraft items made with coconut in which Shri. Hemant Kumar bagged first prize and Kumari Pooja and Shri Pradeep Kumar were awarded second and third prize respectively. The trainees were provided stipend, tool kit and certificate. The objective of conducting this programme under Coconut Development Board schemes was that these trainees could start self employment for generating their own income after obtaining training under skill development programme.

In the concluding session Shri. Ravidra Kumar, Technical Officer, CDB, RO, Patna proposed vote of thanks and congratulated all the trainees for taking part in the training programme .

East Himalayan Expo 2018

Coconut Development Board, Regional Office, Guwahati participated in the 10th East Himalayan Expo 2018 organised by India Trade Promotion Organization at Shillong, Meghalaya from 10th to 17th December 2018. Shri. Tathagata Roy, Hon'ble Governor of Magalaya inaugurated the exhibition. Coconut Development Board exhibited informative posters, various coconut food products, branded coconut oil and oil based products, coconut wood and shell based handicraft items and publications of the Board. M/s. Yogic Foods Private Limited , Tamil Nadu and M/s. Pransu Coco Handicrats, Bihar had their sales cum display counters in the Board's stall. More than 1000 people visited CDB stall.



A view of CDB stall in East Himalayan Expo

PAC of CDB approved 7 research projects worth Rs. 207.35 lakhs



Coconut Development Board (CDB) in its 52nd meeting of the Project Approval Committee (PAC) on Technology Mission on Coconut (TMOC) held at Kochi on 14th January 2019 under the chairmanship of Dr. Raju Narayana Swamy IAS, Chairman, CDB approved 7 research projects with an outlay of Rs 207.35 lakhs out of 25 projects received from various research institutes all over India.

Shri. R.R Sharma, Assistant Commissioner (Horticulture), Govt of India, New Delhi; Dr. KSMS Raghav Rao, Director, CFTRI, Mysuru; Shri. PK Hameed Kutty, Deputy Agricultural Marketing Advisor, Directorate of Marketing and Inspection, Kochi; Shri. Ashok Kumar Nayar, AGM, DDM, NABARD, Idukki; Shri. Philip.Y., Chief Manager, Indian Overseas Bank, Kochi; Shri. R. Madhu, Secretary, CDB, Kochi; Dr. Rajat Kumar Pal, Deputy Director (Dev), CDB, Kochi; Smt. Deepthi Nair S, Deputy Director(Mktg), CDB, Kochi; Shri. Sreekumar Poduval, Processing Engineer, CIT, Aluva attended the meeting.

Krushi Odisha

Coconut Development Board, Stae Centre, Odisha participated in Krushi Odisha-2019 held at Barmunda, Bhubaneswar from 15th to 19th January, 2019. The programme was organized by the Department of Agriculture & Farmers' Empowerment, Government of Odisha in collaboration with Confederation of Indian Industries (CII). Investors meet, farmer scientist interactions, farmers felicitations, extension functionaries conferences and cultural Programmes were held as part of the programme.

Shri. Naveen Pattnaik, Honourable Chief Minister, Odisha inaugurated the programme on 15th January, 2019 at Biju Pattnaik Playground, Baramunda, Bhubaneswar. Coconut Development Board, showcased different coconut based value added products.



2000 people including farmers visited the stall of Coconut Development Board. Officials of Coconut Development Board interacted with the visitors and clarified doubts on coconut cultivation technology, value added products of coconut and on different ongoing schemes of the Board.

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 chlorpyrifos (2ml chlorpyrifos 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

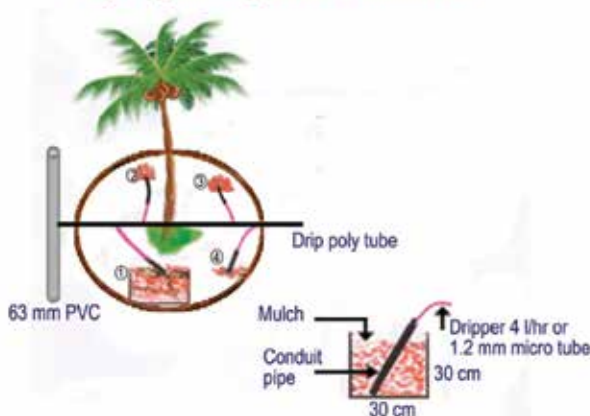
Irrigation has to be continued in coconut gardens. If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm. Drip irrigation is the ideal method of irrigation for coconut. The number of dripping points should be six for sandy soils and four for other soil types.

Depending on the evaporation rate, quantity of water to be provided through drip irrigation system in different coconut growing tracts can be decided. 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

Rainfall received during south west monsoon and north east monsoon in Southern peninsular region during 2018 was less than the long term average annual rainfall. Almost all the coconut growing regions of India received less rainfall and the situation was worse in the case of north east monsoon. Rainfall data made available by India Meteorological Department (IMD) indicate deficit of rainfall received during north east monsoon in 2018 in the major coconut growing districts. Deficit of north east monsoon rainfall in Tamilnadu state ranged from -49 % (Pudukottai) to -21 % (Thanjavur). All districts in Kerala state except Ernakulam, Kottayam and Pathanamthitta received less rainfall compared to the normal rainfall. The deficit of north east monsoon rainfall was more in Kasaragod (-38%), Palakkad (-38%), Thrissur (-29%) and Kollam (21%). The same trend was observed in Karnataka state also and major coconut growing areas received less amount of rainfall and it was deficient in Chikmagalur, Chitradurga, Dakshina Kannada, Mysore, Mandya, Tumkur and Udupi districts. Major coconut growing districts in Andhra Pradesh (East Godavari, West Godavari and Srikakulam) also received less quantity of rainfall compared to the long term annual average. Deficit of rainfall received has resulted in quick depletion of available soil moisture and coconut farmers were compelled to start irrigating coconut palms during the second fortnight of October itself compared to the usual practice of starting irrigation during December. Early start of irrigation can aggravate the problem of reduction in ground water availability and it is quite possible that towards the peak summer days scarcity of water for irrigation will be a major problem in most of the coconut growing areas. Hence, it is imperative that coconut growers

Drip irrigation layout and installation



judiciously use water for irrigation. Drip irrigation has to be adopted to save water. Mulching and other soil and moisture conservation practices should be adopted if not done earlier.



Pest and disease management

The month of February slowly transits into the dry period, however, the nights remain still cooler. The 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. There will be a shift in the parasitism level favouring the pest population to flare up especially in juvenile palms and coconut nursery. The sustenance of key pests like black headed caterpillar and slug caterpillars in endemic zones are to be understood keenly and management strategies evolved accordingly. This weather also encourages the build up of red palm weevil. Rhinoceros beetle incidence in the cyclone Gaja and Titli damaged regions should be monitored carefully. The dry pathogens like leaf rot disease and basal stem rot disease could increase in the endemic regions as well.

Rhinoceros beetle (*Oryctes rhinoceros*)

In the post-cyclone (Titli and Gaja) damaged coastal regions of Andhra Pradesh, incidences of rhinoceros beetle could increase with the availability of breeding materials and coconut linked volatile cues. Furthermore, coconut seedlings planted during May-June should be customarily shielded from pest incursion during this period. More than 0.5% natural incidence of *Oryctes rhinoceros nudivirus* (OrNV) was recorded in Peninsular India and therefore the OrNV-insensitive Coconut Rhinoceros Beetle-Guam (CRB-G) strain is not prevalent in our country, as this strain is

taking a great toll in South-East Asian region causing great concern among International community making extensive damage. The pest invading juvenile palms and nuts is of greater concern these days.

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 along with brushing of teeth and hooking out the beetle from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.
- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.
- Dairy farmers could treat the manure pits with green muscardine fungus, *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. 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



Leaf and inflorescence damage



Shielding by fish net



Metarhizium infected grub

The disease was 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



Rugose spiralling whitefly



Parasitized pupa

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wide array of host plants including banana, bird of paradise, *Heliconia sp.* were also reported.

Management

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

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.



Parasitized pupa



Sooty mould scavenger beetle

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

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.

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

Market review – December 2018

Domestic price

Coconut Oil

During December 2018 the price of coconut oil opened at Rs.15200 per quintal at Kochi and Alappuzha market and Rs.15800 per quintal at Kozhikode market. During the month, price of coconut oil at all three markets expressed an upward trend..

The price of coconut oil closed at Rs.18100 per quintal at Kochi and Rs.17800 per quintal Alappuzha market and Rs.18100 per quintal at Kozhikode market with a net gain of Rs.2900 per quintal at Kochi, Rs.2600 per quintal at Alappuzha market and Rs.2300 per quintal at Kozhikode market.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.13133 per quintal, expressed an upward trend and closed at Rs.16667 per quintal with a net gain of Rs.3534 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.12.2018	15200	15200	15800	13133
09.12.2018	15500	15500	16100	13333
16.12.2018	15900	15900	16500	14000
23.12.2018	16300	16100	16900	14333
31.12.2018	18100	17800	18100	16667

Milling copra

During the month, the price of milling copra opened at Rs.9600 per quintal at Kochi, Rs.9500 per quintal at Alappuzha market and Rs.10000 per quintal at Kozhikode market. The price of milling copra at all three markets expressed an upward trend during the month.

The prices closed at Rs.12000 at Kochi market, Rs.11700 at Alappuzha and Rs.12000 at Kozhikode markets with a net gain of Rs.2400 per quintal at Kochi, Rs.2200 per quintal at Alappuzha market and Rs.2000 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices opened at Rs. 9200 per quintal and closed at

Rs.11800 per quintal with a net gain of Rs.2600 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
01.12.2018	9600	9500	10000	9200
09.12.2018	10000	9900	10300	9200
16.12.2018	10400	10300	10550	9500
23.12.2018	10800	10500	10850	10400
31.12.2018	12000	11700	12000	11800

Edible copra

The price of Rajapur copra at Kozhikode market which opened at Rs. 17800 per quintal expressed an overall upward trend during the month and closed at Rs.18700 per quintal with a net gain of Rs.900 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.12.2018	17800
09.12.2018	17600
16.12.2018	18200
23.12.2018	18300
31.12.2018	18700

Ball copra

The price of ball copra at Tiptur market which opened at Rs.15200 per quintal expressed an overall upward trend during the month and closed at Rs.16400 per quintal with a net gain of Rs.1200 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
	Tiptur
01.12.2018	15200
09.12.2018	15500
16.12.2018	16000
23.12.2018	16200
31.12.2018	16400

Dry coconut

At Kozhikode market, the price of dry coconut which opened at Rs.9250 per quintal expressed a slight fluctuating trend during the month and closed at Rs.9150 per quintal with a net loss of Rs.100 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.12.2018	9250
09.12.2018	9250
16.12.2018	9050
23.12.2018	9050
31.12.2018	9150

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.15000 per thousand nuts and closed at Rs.16000 per thousand nuts with a net gain of Rs.1000 per thousand nuts. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.13000 per thousand nuts and closed at Rs.15000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs. 16500 and closed at Rs.17500 per thousand nuts. At Mangalore APMC market the price of partially dehusked coconut of grade-I quality opened at Rs.20000 per thousand nuts and closed at Rs.21000 per thousand nuts during the month.

Weekly price of coconut at major markets (Rs /1000 coconuts)				
	Nedumangad	Pollachi	Banglore	Mangalore (Grade-1)
01.12.2018	15000	13000	16500	20000
09.12.2018	16000	13000	16500	20000
16.12.2018	16000	14000	16500	20000
23.12.2018	16000	14000	17500	21000
31.12.2018	16000	15000	17500	21000

International price

Coconut oil

The international price of coconut oil and domestic price of coconut oil in Philippines, Indonesia and Srilanka expressed a mixed trend during the month. Whereas the domestic price of coconut oil in India expressed a slight upward trend during the month. The price of coconut oil quoted at different international/ domestic markets is given in the table.

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	India*
1/12/2018	782	763	766	1855
8/12/2018	766	738	747	1884
15/12/2018	768	744	747	1978
22/12/2018	822	770	756	2025
29/12/2018	835	n.q.	764	2261

* Kangayam

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
1/12/2018	460	419	945	1300
8/12/2018	458	413	950	1300
15/12/2018	458	392	923	1342
22/12/2018	480	442	923	1469
29/12/2018	488	440	913	1582

* Kangayam

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*
1/12/2018	121	126	162	424
8/12/2018	121	131	161	424
15/12/2018	120	138	162	438
22/12/2018	122	137	164	438
29/12/2018	120	137	163	466

*Pollachi market

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Processing Technologies in Coconut sector



Vision of CDB

A fully developed and globally competitive coconut industry that contributes to food security, health and nutrition, remunerative price for the coconut farmer and enhanced export earnings for the country and to make India the global leader in value addition and processing in coconut sector.

For promoting and attracting entrepreneurs in coconut processing sector, Coconut Development Board is providing entrepreneurship development and product oriented training at its technical wing "CDB Institute of Technology" (CIT). CIT offers various technical support services to Cooperatives / Farmer Producer Organizations / SHGs / Women groups, private entrepreneurs in setting up coconut based industries

Programmes

- Technological research and development, training and process demonstration of value added coconut products
- Quality testing services for chemical and microbial analysis of coconut based products
- Processing of Neera and production of value added neera products
- Technology transfer for production of neera and value added neera products.
- Offers facility for project works to students of stream MSc, B.Sc, B.Tech and M.Tech in Food Technology/ Food Engineering/ Bio-technology, Chemistry and Microbiology in product development, quality assurance and for improving process efficiency.
- 14 days Neera master technician training programme for traditional tappers.



Those who have undergone training can avail financial assistance of CDB under TMoC.



Technology Mission on Coconut (TMoC)

Financial assistance @ 25% of the project cost limited to 50 lakh for private entrepreneurs and 33.3% of the project cost limited to Rs. 50 lakh per project for SC/ST Women entrepreneurs for establishment of coconut processing units.

Contact number of CIT: 0484 2679680.

अधिक जानकारी के लिए बोर्ड की वेबसाइट देखें : www.coconutboard.nic.in

नारियल विकास बोर्ड

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