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Enhancing Productivity of Coconut through Soil Health Management

Propagation Techniques in Coconut

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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 Neriyamangalam (Kerala), Vegiwada (Andhra Pradesh), Kondagaon (Chhattisgarh), Madehpura (Bihar), Abhayapuri (Assam), Pitapalli (Orissa), Mandya (Karnataka), Palghar (Maharashtra), Dhali (Tamil Nadu), South Hichachara (Tripura) and Fulia (West Bengal) besides a Market Development cum Information Centre at Delhi. The Board has set up a Technology Development Centre at Vazhakulam near Aluva in Kerala.

Functions

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

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

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

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Message from the Chairperson's desk

Dear Readers,

Development of coconut cultivation and production should go hand in hand with the development of coconut industry. Only then the coconut farmers can be assured of remunerative prices for their produce. Board has been working for the integrated development of coconut industry through its scheme Technology Mission on Coconut through which assistance is being extended to prospective entrepreneurs to establish coconut processing units.

The recently held Project Approval Committee (PAC) of the Board has approved 15 research projects for pest and disease management and in processing and product diversification, 17 projects have been cleared for the establishment of coconut processing units with a total project cost of Rs. 43.35 crores. I call upon the potential coconut based entrepreneurs to utilise the benefits extended by Coconut Development Board so that viable coconut processing industry is established in the country.

Apart from this, the Board also provides support for brand promotion. With the increased awareness on the health benefits of coconut products and increasing health awareness among the consumers, investment in coconut sector will definitely offer better prospects for increased return. Let us work together to realise the true potential of coconut sector.

Seasons Greetings and Best Wishes.

G Jayalakshmi IAS

Chairperson

Enhancing Productivity of Coconut through Soil Health Management:

Experiences of Dr. K.M. Nair

C Thamban

Principal Scientist, ICAR - Central Plantation Crops Research Institute, Kasaragod

Farmers seldom realise the market price for their produce commensurate with the cost of production. A major share of the land in Kerala is occupied by long duration perennial crops. Surmounting problems associated with the periodic slump in prices of agricultural commodities is not an easy task for perennial crop production system. It is practically impossible to frequently shift from one perennial crop to another with the changing markets. Compounding the problem is the link of prices of most perennial crops in Kerala with international markets. The strategy for escaping the periodic downturn of market for agricultural commodities is diversification of crops. For the state of Kerala the path to follow is mixed cropping system with multiple perennials and annuals. The combination will enable farmers to sustain profitability even when prices of few commodities slump. Monocrop rubber plantation is a best example of the consequences of ups and downs of market and its effect on domestic economy. Most rubber plantations in Kerala are on small and marginal holdings. The small holder farm households have limited resources and consequently suffered immensely in the face of prolonged slump in rubber prices. Recent small spurt in rubber price is rekindling the hopes of rubber planters.

During the present prolonged market slump of rubber, many small holders have cut down the trees and turned to other crops, many opting for coconut. Coconut based mixed cropping is a viable option in most agro-ecosystems of Kerala except lowlands, high hills and hill plateaus. However, in the light of climatic aberrations and indifferent soil health, it is necessary to enable farmers realise high productivity and profitability through scientific management of coconut based mixed cropping system.

In this context it is worth presenting an instance of scientifically managed coconut based

mixed cropping system by Dr. K. Madhusoodanan Nair in his three and half acre plot of laterite upland at Palamattom, Karukachal, Kottayam district. The plot, under rubber since 1982, was cleared off rubber and other trees in early 2017 and planted with coconut in April/May.

Dr.Madhusoodanan Nair, born and brought up in a small farming family in Kottayam district, obtained his graduate and post graduate degree from College of Agriculture, Vellayani. After completion of studies in 1978 he worked as a Research Assistant in the then Soil Survey Unit of Department of Agriculture for three years. In 1982 he joined the National Bureau of Soil Survey and Land use Planning (ICAR) as a scientist. He had served the Bureau in Jorhat, Assam (1982-86), Nagpur (1986-91) and Bangalore (1991-2016). Dr. Nair who had published numerous research papers in national and inter-national journals is a renowned soil scientist. The last 12 years of his service (2004 to 2016) were devoted to research projects in Kerala on invitation from Kerala State Planning Board. Dr. Nair who retired in 2016 after an illustrious scientific career spanning 34 years decided to be a farmer for the rest of his life.

Kottayam is the land of rubber and most farmers depend on rubber to meet their livelihood needs. When Dr. Nair decided to replace rubber and go for coconut based mixed cropping system his friends and relatives raised their eyebrows and tried to dissuade. The experience gained from more than a decade of research in the state on agro-ecology, soil qualities and in particular coconut based mixed cropping systems instilled in him adequate confidence to face the challenges in his new venture. The last project he led was to demonstrate the feasibility of substantially enhancing coconut productivity through alleviation of soil related constraints to the palm.

For decades, rubber had ensured financial security to Dr. Nair's family as well as lakhs for rubber planters in the state. But with the current focus on sustainable agriculture development and biodiversity, rubber the monocrop, subjected to frequent price slump, ceased to be a viable option. In small holdings multiple mixed cropping systems ensure adequate income for farmers. This was the reason behind Dr. Nair's decision for replacing rubber with coconut based mixed cropping system.

Dr. Nair planted coconut as the main crop with subsidiary perennials areca nut and pepper. For decades farmers in midland laterite had followed the combination before their replacement by mono-cropped rubber plantations. During the gestation period (pre-bearing years) of the perennials intercrop of annuals like banana, ginger, tapioca and other tuber crops ensure income, if not adequate, at least to meet farming expenses. In order to promote biodiversity spice trees like clove and nutmeg and fruit trees like jack, mango, avocado etc. were also planted. Current perennial population is 250 coconut palms and 300 each of areca nut and pepper vine. Additional planting of perennials other than coconut shall continue in ensuing years. On borders and the numerous stone pitched bunds, put in place for soil and water conservation, gliricidia was raised for green manure and fodder grass for cattle. Since Dr. Nair is not rearing cattle, the fodder grass is meant for the cattle of his permanent labourer. Rainwater is collected from roof top and collected in tanks and ponds constructed for the purpose. The rainwater so collected and well water is used for life saving irrigation of crops. All the crops are fertilized according to the recommendations in the Package of Practices of Kerala Agricultural University. However, they were modified in the light of soil test results for the plot. A major problem was faced by Dr. Nair in ginger cultivation. The first two crops were devastated by pests and diseases. During the current season, instead of planting ginger on long raised beds, four seed ginger were planted on mounds formed akin to the ones used for tapioca planting. Four seeds were placed at four corners of slightly flattened top of the mound. The method allowed for adequate plant to plant spatial distance and effectively contained spread of diseases as and when they occurred. Widely spaced planting allowed good aeration and sunlight and consequent profuse tillering and rhizome yield.

Enhancing coconut productivity

Dr. Nair who had made extensive studies on soil qualities, especially of laterite soils, has definite views about managing the soils for high crop productivity. He had tested the soils of the entire plot for its physical and chemical properties. The soils of the plot as in most midland laterite terrain has gravelly clay soils underlain with plinthite at places. The soil test conclusively revealed very strong acid reaction of surface and subsoil and subsoil aluminium toxicity. Three decades of rubber plantation with no input of liming materials and only NPK fertilizers alone was responsible for the strong acid reaction and deficiencies of secondary nutrients calcium and

magnesium and micro-nutrients zinc and boron. The situation called for modification of fertilizer inputs recommended by POP of KAU. The modified soil and palm management followed by Dr. Nair is as follows.

• After clearing the rubber and miscellaneous trees the soil was ploughed using an excavator. Along with ploughing 12 tonnes of dolomite and 5 tonnes of gypsum were incorporated in the soil. The liming materials were to reduce the surface and subsoil acidity. In order to correct the temporary magnesium deficiency developed by heavy input of calcium 200 kg of magnesium sulphate was spread on surface.

• After conditioning the soil of the entire plot pits of size 5x5x5 feet were excavated at a spacing of 9x9x9 meters. Larger spacing was employed to facilitate profuse mixed cropping.

• The soil excavated from the pit was mixed with 25 kg dolomite and two third of the pit was refilled with the dolomite mixed soil. The approximate cost of preparation of the pit was Rs.700/-.

• Coconut seedlings were planted in April/May of 2017. The varieties of coconut used were West Coast Tall (WCT) 100; TipturTall (Karnataka) 25; TxD hybrid 100 and NCD 25.

• Chemical fertilizers were applied according to recommendations of KAU. In addition, dolomite, magnesium sulphate, zinc sulphate, copper sulphate, borax and common salt were annually input for the palms.

• External inputs for three year and older palms are as in the following table. A third of the inputs were given in first year and two third in second year.

Table 1. Soil amendments and fertilizers for an adult palm (three year and older)

Inputs	Fertilizer and Quantity	Mode of application
Pre-monsoon (April-May)		
Major Nutrients: N, P and K	Urea: 500 g Factamphos: 500 g Muriate of Potash: 1 kg	Broadcast over the mulch deposited around the palm base, after receipt of a soil soaking pre-monsoon shower in April or May.
Soil amendments: dolomite (or lime) and Magnesium sulphate.	Dolomite or lime: 2 kg (if quick lime 1.2 kg) Magnesium sulphate: 2 kg	Broadcast over the mulch 15 days after the input of NPK fertilizers.
Micro-nutrients: Zinc, Copper, Boron, Chlorine	Zinc sulphate: 100 g Copper sulphate: 100 g Borax: 100 g Sodium chloride (common salt) 1 kg	Broadcast over the mulch 15 days after the input of amendments.
During North-east monsoon (October)		
Major Nutrients: N, P and K	Urea: 500 g Factamphos: 500 g Muriate of Potash: 1 kg	Broadcast over the mulch deposited around the palm base, after receipt of a soil soaking monsoon rain in October.
Micro-nutrients: Zinc, Boron, Chlorine	Zinc sulphate: 100 g Borax: 100 g Sodium chloride (common salt) 1 kg	Broadcast over the mulch 15 days after the input of NPK fertilizers.

• No organic matter inputs from outside like cow dung, poultry manure, or compost are input for the palm or other crops. In order to ensure adequate organic carbon in soils dry fronds and other palm debris were deposited around the base of the palm.

Also added are debris from other crops. In the farm complete recycling of the crop residues are followed. Amelioration of soil acidity through liming materials and thereby ensuring high levels of calcium in soils promoted abundance of earth worms in the soil. The earth worms and associated macro and micro flora and fauna decomposes the organic debris rapidly. Gliricidia leaf mulch in abundance is the major green manure component.

• The annual ritual of opening and closing of basins around the palm is not followed. Dr. Nair says the process is not necessary in sandy and laterite soils which are highly porous and water permeable.

• Life-saving irrigation is provided during summer months.

The palms in the plot are perfectly healthy and are growing vigorously. No symptoms of nutrient deficiencies are exhibited by palms, except boron. Borax application to the tune of 300 g per year had to be input to some palms to ensure no deficiency symptoms. Dr. Nair is extremely happy these days since at the age of three and half year few tall palms (WCT and TipturTall) had put out spadices. The tall varieties normally do so after five or six years.

The threats faced are from two pests, rhinoceros beetle and red palm weevil. Attack from the beetle started from the very first day of field planting. None of the methods suggested to control the menace of the beetle and weevil were found to be satisfactory. So for three years, every day the palms were examined and the beetles boring into the tissue were extracted and killed. The weevils turned out to be more elusive and lethal. Placing of used fish nets cut to approximate size of 2 square feet at last proved to be an effective means of trapping the beetle without causing damage to the palm. Dr. Nair could also trap few red palm weevils by placing the fish net. It was a farm innovation which was improvised by Dr. Nair. The weevil is turning out to be the Achilles heel in the absence of any fool proof method for early detection.

Regaining lost glory of coconut productivity in the state

Soil chemical degradation and the consequent very strong surface and subsoil acidity and deficiencies of mineral nutrients have led to the decline of coconut pfarming in the state. Following scientific management to regain soil health can increase the productivity of coconut palm and reduce the cost of production. The result of a multi-institutional project initiated by the Kerala State Planning Board and lead by Dr. Nair involving scientifically laid out experiments and demonstrations in farmer's fields at six locations across the state had conclusively proved that coconut yield can be nearly doubled by alleviation of soil related constraints to the palm. Shift in the share of livelihood income of farmers from agriculture to other occupations meant waning interest in agriculture. This the main reason for neglect of small holder coconut based mixed cropping systems and consequent low productivity of the palm. Group farming is a viable option under the situation. Another option is leasing out the holding to interested farmers. Scientific management of the palm based mixed cropping system, value addition of the products and innovative marketing can substantially increase the income from farming. Necessary policy interventions, administrative actions and extension strategies should be put in place by concerned development departments to overcome farmer apathy and increase overall agricultural GDP of the state. Local farmer groups should be formed and encouraged for removing supply side constraints for the external inputs, post-harvest product processing and for community action for control of pests and diseases. Dr. Nair is keen on sharing his farming experiences with fellow farmers. Central/State agencies involved in coconut development and extension can very well use the garden of Dr. Nair for setting up model Farmer Field School.*For additional information*

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Propagation Techniques in Coconut

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Coconut (Cocos nucifera L.) is a major crop in tropical areas, providing cash and subsistence to smallholders. As every part of the tree can be made into universally used products, it is popularly known as "the tree of life". Though India was the first country in the world to evolve a commercial hybrid of coconut (Patel, 1937) and the country has since released many high yielding varieties and hybrids, current production of quality planting materials meets only about 25 percent of the annual requirement of planting material needed for area expansion and replanting. Predominantly cross-fertilized nature of coconut results in enormous variability in the seedling progenies, leading to dearth of quality planting materials. This article describes the major advances in propagation techniques of coconut palm, conventionally, by seeds and through plant tissue culture techniques.

I.a. Seed propagation

Seed propagation is the only viable method of producing planting materials in coconut palms. Coconut is long lived and has a very long juvenile phase. The performance of coconut palm can be judged only after 10-15 years of planting. The long life span and large capital outlay involved in establishing a coconut plantation necessitates the use of quality planting materials as a first step for the successful cultivation of the crop. If poor planting materials are used for planting, the new plantation can prove to be uneconomic, causing considerable loss of time and money to the grower. Coconut being a perennial crop, poor selection continues as a source of loss throughout its life period. Through a series of selections made at different stages, it is possible to obtain quality seed nuts and seedlings. Hence, for production of quality planting material of coconut,

1.Seed propagation -WCT mother palm

2. Seed propagation-Seednut

3. Seed propagation
-seedling selection

4. Hybridization- Dwarf parental palm

6 Hybridization Dx T hybrid nut

5. Hybridization Tall parental palm

7 Hybridization Dx T hybrid

a three tier selection approach is adopted starting from mother palm selection, seed nut selection and seedling selection.

In India, about 30 varieties have been developed and released for commercial cultivation through mass selection by ICAR-CPCRI, State Agricultural Universities and coordinating centres under All India Coordinated Research Project on Palms. These released varieties are propagated by identifying typical mother palms of the respective variety and collecting open pollinated nuts from the selected mother palms. Seedling selection is done based on the morphological characters like vigour and petiole colour confirming to their mother palms.

Important features of superior mother palms:

• Palms should be regular bearers and should yield 80 or more nuts/year under rainfed conditions and 100-120 nuts/year under irrigated condition.

• Palms should have typical characteristics of the variety with regard to palm traits, crown, leaf and nuts

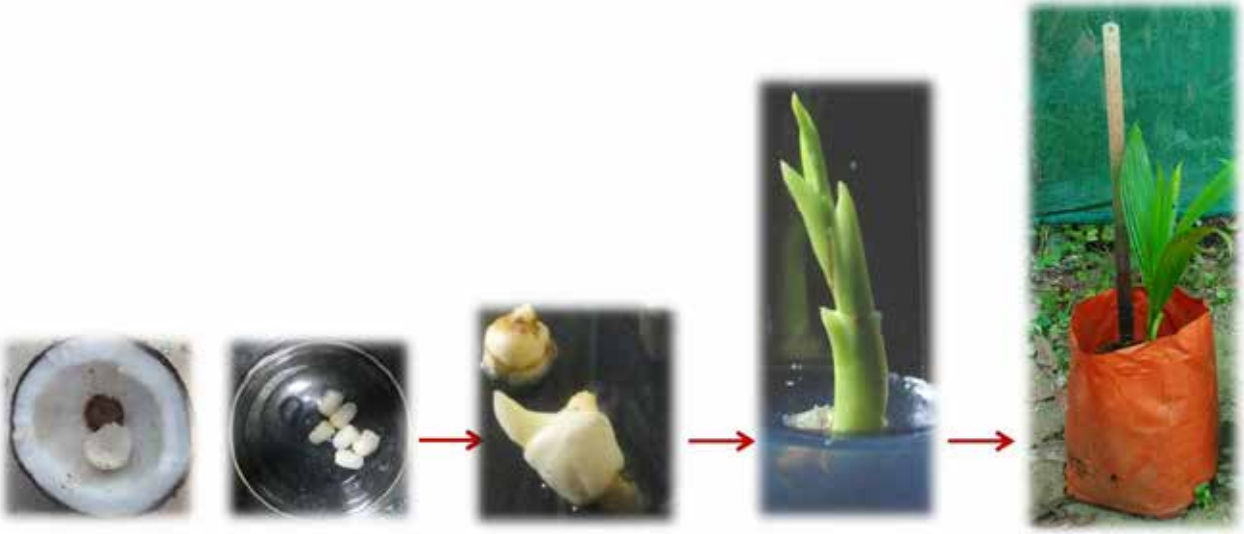
• Palms should have short and stout inflorescence stalk with bunches, preferably resting on the leaf petioles of the lower whorl.

• Palms with more than 30 leaves and 12 inflorescence carried evenly on the crown

• Palms should be more than 22 years of age

• Palms should be free from all diseases and pests.

For producing planting material for the root (wilt) disease prevalent tract, select healthy and high yielding palm located in the midst of root (wilt) affected palms. The disease-free status of mother palms should be confirmed by serological testing. The age of West Coast Tall (WCT) mother palms should be more than 35 years and should be surrounded by palms of which atleast 80% are affected by root (wilt) disease.



Seed nut selection

Seed nuts can be collected from selected palms when nuts attain full maturity. In Talls it takes usually 11-12 months for maturity, whereas in Dwarfs, they mature in 10-11 months. Nuts should not be damaged while harvesting. Discard nuts having irregular shape and size. Harvested nuts can be stored in shade to prevent drying up of nut water. Harvested seed nuts should be stored in shade to prevent drying of nut water, till their husks become completely dry. Seed nuts of tall variety can be stored upto two months after harvest. The seed nuts of dwarfs should be sown within 15 days of harvest.

Seedling selection

Selection of seedlings is as important as the selection of parental palms and seed nuts. In the case of WCT, ungerminated nuts, multiple sprouts, thin/etiolated, bent/spindled and albino seedlings can be removed from 150 days from the date of sowing and in dwarfs culling can be taken from 120 days onwards. If rigorous standards of selection are adopted, 60 to 65 % quality seedling can be obtained from the total nuts sown. An ideal one-year-old coconut seedling has the following characters:

1) Seedlings should be healthy, vigorous and robust- looking, with large numbers of leaves, good girth at the base, short, thick leaf stalks and large number of roots.

2) Early germinated nuts give better seedlings than the late germinated ones and are associated with early bearing

3) Early splitting of leaves into leaflets is a good sign of vigour

4) From the one-year-old nursery, select vigorous seedlings having minimum of six leaves and girth of 10 cm at the collar.

Seedlings of dwarf varieties can be easily identified by their early germination, short height, short and sturdy leaves with short and narrow leaflets and early splitting of leaves. Different dwarf varieties are easily recognized by their colour of petiole.

I. b. Hybridization

Among the several breeding methods, exploitation of heterosis has the maximum impact on improvement of cross-pollinated crops. Since the desired characters such as high yield, precocity in bearing, better quality, high copra and oil content, drought tolerance and disease resistance are distributed among different varieties or different individuals of the same variety, hybridisation is the most useful method to bring together the desirable traits. Harland advocated the exploitation of hybrid vigour to increase the productivity of coconut. A new dimension to coconut improvement was added with the discovery that the hybrids made by Patel (1937) between Tall and Dwarf cultivars showed enormous vigour, enhanced production potential and early bearing tendency. The reciprocal combination of Dwarf X Tall showed an even higher productivity, indicating strong possibility of cytoplasmic influence of the dwarf parent. During 1970-1990 production of T X D hybrids was common throughout India. However, efforts to evaluate D X T hybrids started simultaneously and the first D X T (Chandra Sankara) was released by ICAR-CPCRI during 1985. Nowadays, D X T is more common due to the ease with which it can be produced compared to T X D hybrids.

Hybridisation technique

▶ *a. Emasculation*

The first step in hybridization is the removal of male flowers from the inflorescence of the female parent to avoid self pollination. This is called emasculation. To avoid chances of pollen contamination it is better to do the emasculation in the initial few days after the opening of the inflorescence. This is done either by removing the individual male flowers by hand or by cutting the spikelet (with knife/secature) about 4 to 5 cm away from the upper most female flower and removing the remaining male flowers by hand. Generally, 1 to 2 male flowers are found attached to the base of the female flowers and care should be taken to ensure that these male flowers are also removed at the time of emasculation. In WCT mother palms, emasculation is done by cutting the spikelets 5 cm above the female flowers within 10-14 days of opening of the inflorescence. When dwarf varieties are used as female parent, emasculation should be carried out within 5-6 days of the opening of the inflorescence.

▶ *b. Bagging*

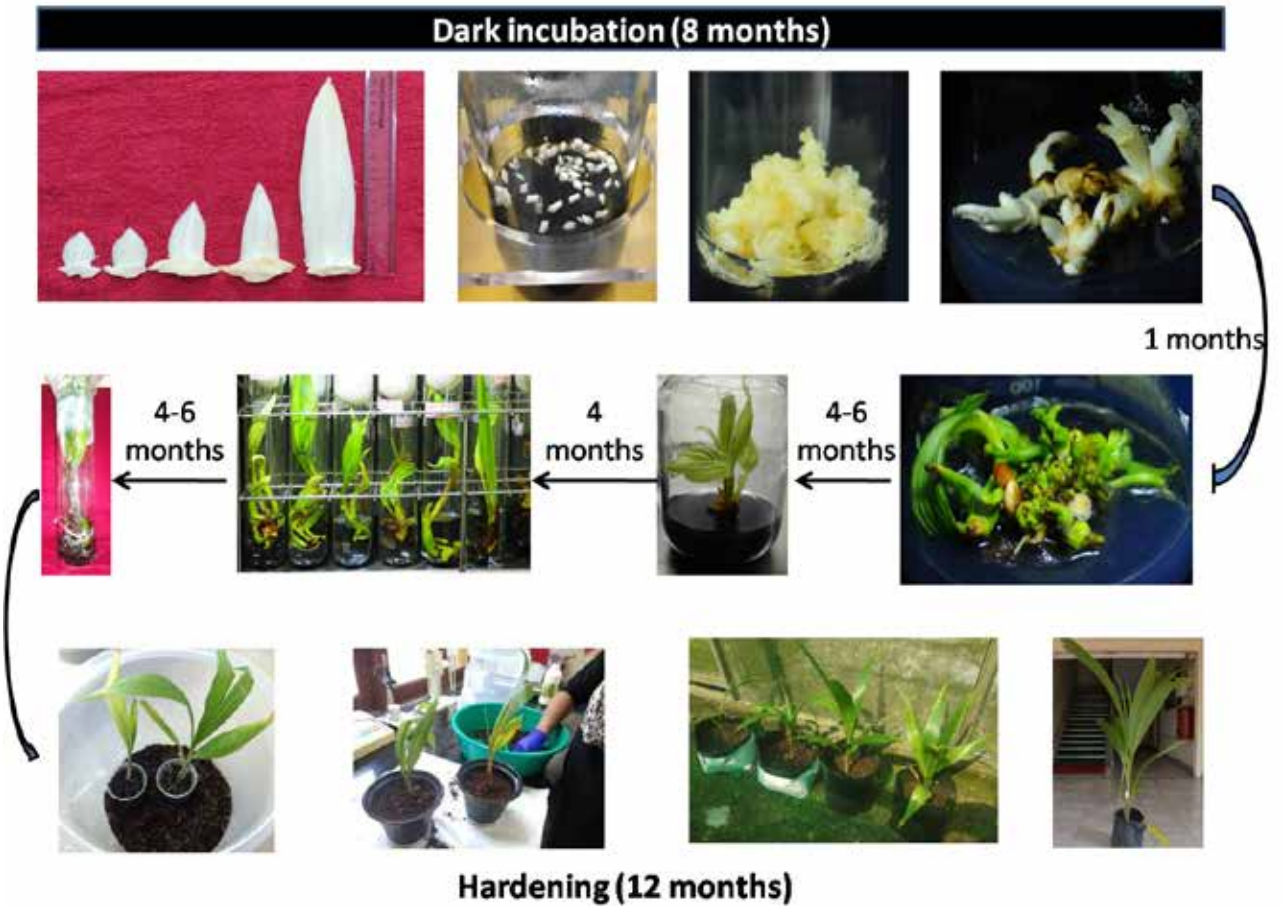
A few days before the female flowers become receptive; the inflorescence is covered and tied firmly with the pollination bag. In WCT, the 'buttons' or female flowers become receptive approximately 19-21 days after opening of the inflorescence and pollination is carried out when female flowers become receptive. Receptivity of a single female flower will last for one to two days. In dwarf varieties, the female flowers become receptive 8-16 days after bunch opening (depending on the variety). In Chowghat Green Dwarf the female flowers become receptive within 6-8 days and continue up to 14-18 days whereas in Malayan Green Dwarf the receptive period is from 16-23 days after bunch opening.

▶ *c. Collection of male flowers and processing of pollen*

To carry out artificial pollination in coconut it is necessary to collect and store the pollen to carry out pollination as and when the female flowers become receptive. Maturity of the anthers is indicated by the bluish green tinge at the tip. These mature male flowers should be kept, in between two sheets of thick paper and pressed gently, using wooden ruler and dried by keeping at 38-40^{o}C in an incubator, for 24 hours. By sieving the dried male flowers, we get the yellow coloured dust of pollen grains. Pollen may be preserved in polypropylene vials, in desiccators for about 10-12 days without losing its viability.

▶ *d. Pollination*

The pollen grains and chalk-powder should be mixed in 1: 9 ratio and filled in the applicator, just before use. The receptivity of the female flowers (buttons) is marked by the honey like exudates from the ivory coloured stigma, which can be seen through the transparent plastic window of the pollination bag. At this stage, a small hole should be made in the plastic sheet. Insert the tube of the applicator through this hole and press the rubber bulb to spray the pollen-chalk mixture inside the bag. Care should be



taken to close the hole after spraying the pollen-chalk mixture, using adhesive tape. All female flowers do not attain receptivity on the same day, so the above process should be continued till all the buttons in the inflorescence become receptive. It should be kept in mind that the pollen from the same parent should be used for individual inflorescence and since the honey dries progressively during the morning hours, 7-11 am is the most preferred time for conducting artificial pollination.

▶ *e. Bag removal and labeling*

On completion of fertilization the stigma turns brown and the secretion of honey stops. Three days after the last pollination (on the last female flower to attain receptivity), the pollination bag should be removed and the bunch should be labelled properly, to retrieve the details of the cross later at harvest. As usual, 10 to 12 months after pollination, mature nuts can be harvested.

Identification of hybrid seedlings

Hybrids usually express hybrid vigour in the nursery for vegetative characters such as height, girth at collar and number of leaves in the seedlings. The colour of the petiole and vigour of the seedlings can be used as a selection criterion for hybrid seedlings in the nursery. Hybrid usually exhibit hybrid vigour at the seedling stage itself and petiole colour of the hybrid seedlings may range from green/ brown/ intermediate shades of the parents.

In India, nearly 20 coconut hybrids have been developed and released by ICAR- Central Plantation Crops Research Institute and State Agricultural Universities.

For production of hybrids, artificial pollination need to be carried out every time using selected mother palms using the pollen collected from concerned male parent. That means the hybrid palm should not be used as mother palm and the progeny obtained from a hybrid palm should never be used for planting. Because of the segregation in subsequent

generation, the chance of obtaining hybrid vigour is very less in such seedlings.

▶ *II. APPLICATION OF TISSUE CULTURE TECHNIQUES IN COCONUT PROPAGATION*

Mass multiplication of elite coconut palms, with high yield and resistance to biotic and abiotic stresses, is the need of the hour for obvious reasons. Unfortunately the progress achieved in clonal propagation in coconut has been rather sluggish. The recalcitrant nature of coconut is the main impediment for development of a commercial scale protocol for in vitro multiplication. Selection of explants is the key element for its successful outcome. Numerous tissues viz., leaves, inflorescence, plumular tissues, ovaries, anthers, roots and zygotic embryos have been utilized as explants for coconut tissue culture. Major advances in the application of plant tissue culture techniques in coconut propagation are coconut embryo culture, plumule culture and immature inflorescence culture.

II. a. EMBRYO CULTURE

The success of in vitro germination of coconut zygotic embryos provides an alternative way of transportation of coconut germplasm in the form of embryo cultures. This method also avoids the formalities of quarantine regulations, which include treatments of the nuts with insecticide, fungicide and fumigation. Further, embryo collection also considerably reduces the transportation cost as 500 seed nuts weighing 600-700 kg can be transported in one briefcase containing 500 embryos weighing 5-6 kg (including weight of briefcase). Standardization of embryo culture protocol in coconut can benefit in embryo rescue, collection and exchange of coconut germplasm and in vitro screening for biotic and abiotic stress.

The protocol for embryo culture developed at ICAR-CPCRI (Karun et al., 1999) has successfully been used in germplasm expeditions since early 2000's. Another important application of embryo culture is in the germplasm collection and exchange. Collecting and exchange of coconut germplasm is difficult and not economic because of short dormancy and bulkiness of the seed resulting in seed germination when stored for more time in a germplasm expedition. Moreover phytosanitary restrictions too severely limit the germplasm introduction. Standardization of embryo culture technique provides an easy and safe alternative for the movement of coconut germplasm and is emphasized in the technical guidelines of FAO/IPGRI (Diekmann, 1997).

"Standardization of embryo culture protocol in coconut can benefit in embryo rescue, collection and exchange of coconut germplasm and in vitro screening for biotic and abiotic stress."

Embryo rescue

Embryo rescue is an effective technique for obtaining plantlets in vitro from embryos which either fail to germinate in nature or exhibit delayed germination. Mohachao Narel is a coconut variant reported from Guhaghar taluk of Ratnagiri District of Maharashtra, which is characterized by sweet and soft kernel and has less fibre content (Samsudeen et al., 2013). The weight of embryo obtained from sweet endosperm nuts was significantly lower than nuts possessing normal endosperm. This may be the reason which hinders its germination under natural conditions. To overcome this problem, embryos from sweet kernelled nuts were 'rescued' via embryo rescue and plantlets could be regenerated successfully through the embryo culture protocol standardized by ICAR-CPCRI.

II. b. PLUMULE CULTURE

Coconut plumular culture protocol (Karun et al., 2008) could be applied for rapid multiplication of dwarf palms and also for in vitro conservation of genotypes. Besides increasing the multiplicative rate of coconut to many folds, plumule culture will be handy while initiating transformation studies as the culturing period is considerably less when compared with other explants. Further when a genotype is cryopreserved in the form of embryos, its regeneration in large numbers could be possible by means of plumule culture.

Extraction of explants

- Scoop out zygotic embryo with a portion of endosperm using a cork borer from dehusked and split opened 10 months old mature coconuts.
- Extract the embryo from the endosperm with the help of scalpel or blade
- The extracted embryos are surface sterilized with 20 % sodium hypochlorite for 20 minutes followed by 4-5 washes with sterile distilled water

Inoculation

Inoculate surface sterilized embryos into Y3 medium containing 3% sucrose and 1 g/litre charcoal and agar 5.5 g/litre. The embryos are inoculated in test tube containing 20 ml solidified media and incubated in dark condition. After one month of incubation, slice out the plumular region of embryo with the help of a sharp scalpel. Each plumular region can give about 4-5 slices. Inoculate these explants into same basal medium supplemented with 2,4-D (16.5 mg/L) with TDZ (1mg/L) and incubate in dark for callus induction. Sub culture the explants to same basal media supplemented with 2,4-D , BA and TDZ. Gradually reduce 2,4-D concentration from 8.25 mg/L to 4mg/L, then to 2 mg/L at each monthly and finally media free of 2,4-D.

Plantlet regeneration

Observe somatic embryogenesis with an incubation period of 16 weeks. Transfer germinated embryos with two leaves and primary leaves to liquid rooting media. Developing plantlets should be subcultured atleast once every 4-5 weeks. Select plantlets with well developed root and root system for hardening.

▶ *II. c. IMMATURE INFLORESCENCE CULTURE*

Immature inflorescence contains numerous meristematic points and therefore is considered a potential source of explant to clonally propagate important crop plants. The success depends on the selection of inflorescence of correct maturity stage. The technique can be used to propagate adult coconut palms, whose performance has been established (e.g. productivity or resistance to diseases). The advantage of rachillae explants from immature inflorescence is that it enables multiplication of adult bearing palms of known performance for production of true-to-type planting materials which otherwise is not possible in a cross pollinated crop like coconut. Hence, this method can be used as clonal propagation technique for tall palms. The technique involves inoculation of rachllae bits of 1 mm size in Y3 media supplemented with 2,4-D and incubation in dark for a period of eight months. The white shoot like outgrowths were transferred to ½ MS media containing NAA and BAP and incubated in 16 hours light conditions. The multiple shoots developed were separated and cultured in shoot regeneration medium containing Y3 media fortified with NAA and BAP. The plantlets with 3-4 leaves were transferred to rooting medium and after developing sufficient roots, the plantlets were transferred to potting mixture containing cocopeat: vermiculite for hardening. Even though ICAR-CPCRI has succeeded in plantlet regeneration from immature inflorescence explants, lot of refinement is further required for developing a commercial scale protocol. Standardization of the regeneration protocol from immature inflorescence will lead to mass production of elite, high yielding and disease-resistant planting materials. ■

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Obituary

Veteran agriculture expert and former Director of Agriculture, Government of Kerala, R Hali (87) passed away on 13th December 2020. He was a member of the Kerala Agricultural Policy Committee, one of the pioneers of farm journalism in Kerala and was a frequent contributor of articles for Indian Coconut Journal and Indian Nalikera Journal.

CDB places on record deepest condolences on his demise.

Mooting one per 1000 policy initiative to rejuvenate coconut soils

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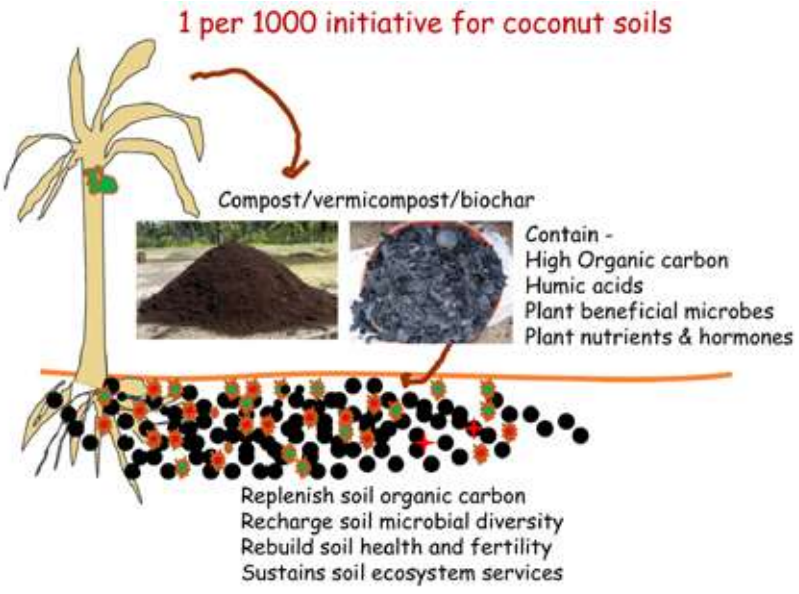
Coconut cultivation and soil organic carbon

Coconut palm is widely grown in coastal and hinterlands of India where the soils are predominantly characterized with low organic matter and thus, poor organic carbon. The soil organic carbon (SOC) content is a good indicator of soil fertility as it is directly related to nitrogen supplying capacity of the soils (Baert and Van Rast, 1998). The SOC also is the food for millions of diverse soil microorganisms and correlates to the soil microbial biomass content which is a key driver of the soil ecosystem services (Gopal et al., 2013). Higher SOC helps soil to retain more plant nutrients and water while it improves the soil physical parameters for better root growth resulting in good crop stand. In an elaborate study conducted in Kerala where the area under coconut is highest in India, it was reported that the soil organic carbon was low (below 1 to 0.5%) in surface soils and lesser (mostly <0.5%) in sub-surface soils (Nair et al 2018b). Low SOC coupled with sub-par pH are some of the main reasons for poor coconut productivity of about 40 nuts palm-1 year-1 in India (Jnanadevan, 2013; Nair et al., 2018a). Studies in some parts of southern Karnataka have also shown that the organic carbon content ranged between 0.10 to 1.49% with electrical conductivity (EC) ranging between 0.01 to 0.22 dS m-1 indicating low status of anions and cations which are critical for nutrition of coconut palms (Avinash et al., 2019).



Low productivity could drive millions of Indian coconut farmers to extreme distress as they depend on this crop for their livelihood. Future of several industries that require essential raw material from coconut palm could also become bleak because of poor coconut productivity. The humid tropic conditions prevailing in coconut growing tracts hasten the loss of soil organic carbon due to high temperature and humidity. Moreover, heavy and ill-distributed monsoon precipitation influenced by climate change also adds to loss of soil organic carbon due to erosion of precious top soil. The 2018 floods in Kerala had indicated an increase in 80% rate in soil erosion with low organic carbon being one of the main reasons for the high

soil erodibility factor K in the range of 0.10 to 0.17 (Chinnasamy et al., 2020). Senility of one-thirds of the palms in Kerala and 20% of palms in India acts as a compounding factor driving to poor nut productivity (Murthy, 2017). Overall, coconut cultivation is beset with multiple challenges that hinder the overall production and productivity of the palm.

Keeping soil alive

This year's World Soil Day-2020, themed 'to keep soil alive' and 'protect soil biodiversity' through enrichment of soil organic carbon and micro/macroflora and fauna is but the right time for proposing a policy initiative to recharge the organic carbon content of soils of coconut cultivated throughout India. The long standing committed work and awareness creation of Prof. Rattan Lal, Ohio State University, USA for rejuvenating the soil through improving soil organic carbon which fetched him The World Food Prize-2020 caught the attention of the world of the organic carbon as the currency for sustaining soil's crop production ability. In line with Prof. Lal's tenet and the pioneering International initiative of France to improve soil organic carbon through the '4 pour 1000' programme (4‰ i.e., improvement of 0.4% carbon year-1) (www.4p1000.org/), a modest 1 per 1000 (0.1% carbon year-1) increment of soil organic carbon can be planned and executed for coconut soils in India. Because, even a small increment of 1 mg C ha-1 in organic carbon pool in root zone of crops has shown to increase yields by 20-70 Kg ha-1 for wheat, 10-50 Kg ha-1 for rice and 30-300 Kg ha-1 for maize (Lal, 2006). In other words, if the soil organic carbon pool can be increased above critical level (10-15g/kg soil), it will help significantly in restoring the soil's crop production ability (Lal, 2015).

Returning carbon to soil through coconut residue management

There is a good scope for implementing 1 per 1000 in coconut farming, because, coconut palm, grown in about 2 million ha in India is known to generate close to 25 million MT of highly recalcitrant lignin-rich biomass residues annually. ICAR-CPCRI has developed pioneering recycling technologies of the recalcitrant biomass residues from coconut such as vermicomposting of coconut leaves (Prabhu et al., 1998; Gopal et al., 2019), urea-free coir-pith composting (Thomas et al., 2013; Gopal et al., 2016), biochar production from different residues of coconut palm (Gopal et al., 2020) and presently standardizing tender and mature coconut husk composting. The final products of the recycling technologies are rich in organic carbon (above 20%), above 6.5 pH value and possess wide diversity of microbiota. For example, coconut leaf vermicompost was found to have rich and diverse populations of plant beneficial microbiota when analyzed by culture-dependent (Gopal et al, 2009) and next-generation 16s rRNA sequencing method (Gopal et al., 2017); its application had clearly showed temporal enhancement in soil microbial community, microbial biomass and nutrient availability (Gopal et al., 2010, Gopal et al., 2012). Being an output from lignin-rich biomass, the manures/biochars have the ability to add less easily decomposable organic carbon leading to higher carbon sequestration in soil. Application of FYM+vermicompost+coir-pith compost along with vermiwash spray and Azotobacter has recently been reported to enhance significantly the carbon sequestration potential in coconut based cropping system (Naveen Kumar and Maheswarappa, 2019, Shinde et al., 2020). The microbiome addition via manures takes care of widening the microbial diversity of the soil as well as improving the soil ecosystem services (Gopal et al., 2010; Khadeejath Rajeela et al, 2016; Gopal et al., 2020). The manures are also an important source of macro and micronutrients as well as plant growth promoting hormones, albeit in lower quantities. They improve the water holding capacity of the soils which results in better water retention and aid in drought management. Several studies in CPCRI have confirmed the above qualities of the manures/biochars produced by recycling of the coconut biomass residues. Thus, adoption of the recycling technologies will help coconut farmers in multiple ways: improve critical organic carbon content in soil, enhance yield of coconut palm in sustainable manner, keep area clean which helps to reduce pest and pathogen load resulting in improved economic returns.

1 per 1000 initiative to rejuvenate coconut soils

With this background, it is not implausible to moot the 1 per 1000 (0.1%) annual increase in organic carbon in coconut soils through the application of recycling technologies developed by ICAR-CPCRI as mentioned above. This can be initiated through the collaborative efforts of ICAR-CPCRI, Coconut Development Board (CDB), local government agencies including Start-up mission, non-profit organizations and coconut farmers. To run a pilot

programme, Farmer Producers Company (FPO) can be selected to implement the 1 per 1000 initiative. It will broadly involve the following important steps:

i) aggressive awareness creation in coconut farming community regarding the knowledge on soil organic carbon (SOC) and its importance to coconut cultivation and productivity,

ii) generate benchmark values of organic matter and organic carbon content of coconut soils in selected FPO garden using advanced analytical procedure,

iii) develop integrated soil maps of plant-nutrients and microbial indices to demarcate the low, medium and high SOC tracts of coconut,

iv) correlate the yield and quality (oil and tender coconut water) parameters of the coconut in the different SOC tracts,

v) initiate 1 per 1000 strategy to improve the SOC content of coconut soils as a mass movement taking advantage of the palm-residue recycling technologies developed by ICAR-CPCRI,

vi) Periodic estimation of organic carbon (long term carbon) along with soil properties (nutrient and microbiological) post implementation of 1 per 1000,

vii) Correlation of nut yield with the improvement in soil organic carbon,

viii) Developing a coconut carbon bank passbook for the FPO.

To begin with, the 1 per 1000 initiative can be implemented for three or five years on project basis with funding from the Government. This will help coconut farmers realize and experience the importance of adding organic matter for improving the overall soil ecosystem services. Then onward, to adopt it voluntarily by FPOs, an incentive based approach should be espoused to promote the 1 per 1000 drive. Good incentives by the Government in the form of PES (payment to ecosystem services) to FPO which can show best improvement in carbon bank pass book records (validated by empirical data) will help to convert the initiative into a movement. This initiative will also help establish decentralized production of quality organic manures via recycling of coconut biomass residues, improve the cleanliness of coconut gardens and impact the overall health of society in a positive manner. Thus, the 1 per 1000 needs a policy push for implementation and adoption by coconut farming community which will help Indian agriculture and the farmers to achieve food security in an environmentally sustainable manner. ■

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Commercial flower crops in coconut garden under different agro-climatic conditions

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In the present scenario of fluctuation of coconut price and high production cost, and increasing incidence of pests and diseases in addition to low and erratic rainfall, cultivation of coconut as a mono crop is no more economical. Hence, there is need to follow crop diversification and intensification in coconut gardens with compatible crops to increase the productivity and income by ensuring effective and efficient utilization of soil space and solar radiation. Flower crops are important in our daily life as well as national economy. Government of India has identified floriculture as a sunrise industry and has accorded it 100% export oriented status. Owing to steady increase in the demand of flowers, floriculture has become one of the important commercial trades in Agriculture. Hence, commercial floriculture has

Coconut based intercropping with flower crops requires short period of planting time, smaller area , which can provide additional income to coconut farmers. Commercial flower production helps in increased earning for the farmers.

Table 1. List of Flower crops grown in different centres	
Region	Flower crops
	Chrysanthemum (*Dendranthema grandiflora*), Celosia (*Celosia sp.*), Marigold (*Tagetes erecta*), Zinnia (*Zinnia sp.*) and Gomphrena (*Gompherena globosa*)
Arsikere (Karnataka)	Jasmine (*Jasminum multiflorum*), Chrysanthemum (*Dendranthema grandiflora)*, Crossandra (*Crossandra infundibuliformis),* China aster (*Callistephus chinensis*) , Marigold (T*agetes erecta)*
Ratnagiri (Maharashtra)	Jasmine (*Jasminum sambac),* Jasminum multiflorum, Lily *(Lily sp),* Heliconia *(Heliconia spp).* Champaka *(Michelia champaka)*
Kahikuchi (Assam)	Tuberose (*Polianthes tuberosa*) var. Single, Gerbera (*Gerbera jamesonii*) var. Red Monarch, Bird of Paradise (*Strelitzia reginae*) var. Glauca, Gladiolus (*Gladiolus grandiflorus L.*) var. Oscar, Marigold *(Tagetes erecta)* var. Siracole

emerged as hi-tech activity-taking place under controlled climatic conditions inside greenhouse, and is being viewed as a high growth Industry. Coconut based intercropping with flower crops requires short period of planting time, smaller area (unutilised spaces between coconut), which can provide additional income to coconut farmers. Commercial flower production helps in increased earning of the growers. Flowers can also be a source of huge foreign currency by exporting them.

All India Coordinated Research Project on Palms (AICRPP), has been an important contributor to the region's specific coconut research and development effort. Performance of commercial flower crops under coconut in different agro-climatic regions is one of the priority areas of research under AICRP on Palms to evaluate the impact of intercropping flower crops in coconut on productivity per unit area and economics of the system. A field experiment was conducted for four consecutive years, 2012–13 to 2015–16 at Aliyarnagar (Tamil Nadu), Kahikuchi (Assam), Arsikere (Karnataka) and Ratnagiri (Maharashtra). Details of flower crops grown are given below.

In Aliyarnagar centre results showed that in a Coconut + Marigold intercropping system, an average flower yield of 6,053 kg/ha was recorded from marigold with a net income of Rs. 2,54,983 /ha and B:C ratio of 1.87 followed by Coconut + Gomphrena with a net income of Rs. 2,40,458/ha and B:C ratio of 1.85.

At Horticultural Research Station, Kahikuchi, the mean flower spikes production per ha was 314987 in Tuberose, 743200 in Gerbera, 32175 in Bird of Paradise, 61987 in Gladiolus and 20810 kg/ha in Marigold. Intercropping system of growing gerbera in coconut garden recorded the highest net income (380075/

ha) and B: C ratio (3.5) followed by tuberose (323420/ha and 3.1), gladiolus (315090/ha and 2.9), marigold (233050/ha and 2.8) and bird of paradise (199360 and 2.7). The monocrop of coconut recorded significantly the lowest net income of 64050 ha-1 and B: C ratio (1.6). Hence, intercropping of gerbera, tuberose, gladiolus and marigold with coconut can be recommended for Assam condition.

The mean yield of flowers Arsikere centre was 1045 kg/ha in jasmine, 4393 kg/ha in chrysanthemum, 1070 kg/ha in crossandra, 2158 kg/ha in China aster and 4874 kg/ha in marigold. The cropping system of coconut + chrysanthemum recorded significantly higher net income (Rs. 2,00,558/ha) followed by coconut + crossandra (Rs. 1,79,483/ha).

With respect to Ratnagiri centre, Jasminum multiflorum recorded 48656kg/ha, Heliconia spp. recorded 96982.5 number of spikes/hectare, Jasminum sambac recorded 1123.2 kg/ha followed by Michelia champaka recorded 12690 number of flowers. In respect of economics, Coconut + Lily spp. system recorded the highest net return of Rs. 4,79,985/- hectare followed by Rs 3,37,501/- in Coconut + Jasminum multiflorum and Coconut +Heliconia, Rs. 2,18,905/-.

By intercropping with seasonal flower crops, the coconut farmer can earn additional income from the garden without affecting the yield of the main crop.■

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Coconut Tree Climbing Equipment

Boon to Rural People for Year-round Income and Employment - Case Study

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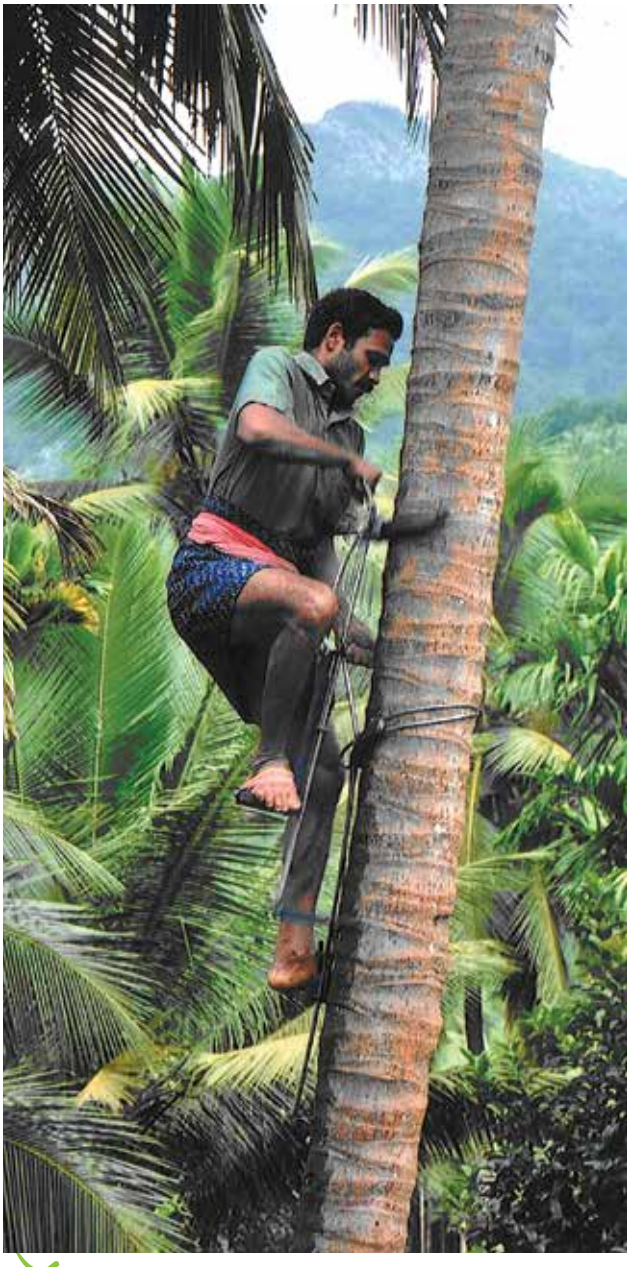

Coconut (*Cocos nucifera L.*) is the most valuable gift of nature to humankind and is commonly known as KALPAVRUKSHA, which fulfills many vital human needs. It is unique among horticultural crops as a source of food, drink, shelter, fiber, medicine and a variety of raw materials for industrial use. The coconut tree grows upto a height of 30 meters depending upon the variety. The tall coconut trees had become bane to harvest coconut at right time due to paucity of climbers. The physical strain and occupational risk involved in climbing had prevented people (especially women) from climbing coconut trees. Further, the delay in harvest of mature coconuts has increased the theft of fallen nuts from the orchard which reduces the income of the farmers. People from rural areas are migrating towards cities for job and other livelihood which has lead to the dearth of persons in coconut harvesting. Coconut Development Board has introduced a programme called FoCT for extending training in coconut harvesting with the help of a climbing equipment. By attending this training programme many people have sustained their livelihood and has chosen coconut tree climbing as a profession. In this connection, here is an example of a person from Mandya taluk who took coconut tree climbing as a profession for his livelihood.

Rajanna, aged about 62 years residing in Keragodu Hobali of Mandya taluk is climbing coconut tree as a profession since 14 years. He is familiar as a coconut tree climber in several villages which are surrounded by Keragodu namely, Ankannana Doddi, Bokkegowdana Doddi, Kalmanti Doddi ,Kod iDoddi, Maralingana Doddi, Panchegowdana Doddi, Siddegowdana Doddi and Taalemele Doddi. He is popularly called as Coconut Rajanna (Tenginakaayi Rajanna in Kannada) by the people and they contact him over phone for harvesting of coconuts. Usually, Rajanna is taking two to three days to harvest the

nuts, as he is busy in attending harvesting of nuts every day without any gap.

Before using the climbing equipment, Rajanna could climb only 17 coconut trees in a single day due to the physical strain involved during climbing at this his age. Further, he could climb for about 20 days in a month due to small injuries which would occur during climbing. The average charge for climbing a tree ranges from Rs.25 to 30 depending on the height of the tree. Thus he could earn an annual income of Rs. 1,02,000 (table 1).

During 2019, Rajanna purchased coconut tree climbing equipment for Rs. 4600.Initially, he could climb only 23 to 25 coconut trees per day but later on with practice he was able to climb 39 trees. This was made possible by using the coconut tree climbing equipment. As the equipment requires less physical strain to climb the tree, the annual employment days was gradually increased from 240 days to 288 days with an improvement of 20 percent. Therefore, the overall annual income from climbing coconut tree was increased from Rs.1,02,000 to Rs. 2,80,800 with an increase of 175 percent (table 1). Rajanna also acts as a village level trader who purchase mature nuts from farmers and sell to the whole saler with the minimal margin of Rs. 2 per kg of coconut.

Table 1: Annual income and employment of coconut tree climber with manual and tree climbing equipment

Particulars	Harvesting of coconuts through manual climbing method	Harvesting of coconuts through coconut climbing equipment	% increase
No. of coconut trees climbed and harvesting nuts in a single day	17	39	129.41
Charges for climbing and harvesting of nuts (Rs./ tree)	25	25	-
Average Annual Employment days of climbing coconut trees	240	288	20.00
Annual Income	**1,02,000**	**2,80,800**	**175.29**

The major problems faced by the coconut tree climber is presented in Table 2. Presently, Rajanna is using wired equipment for climbing coconut trees. Though he was aware of advanced climbing equipments, he could not afford to purchase the

equipment due to high cost. Further, he was facing difficulties while climbing straight trees. Not insured for occupational risk during climbing the tree and need to change iron wire for about 6 to 8 months which requires huge cost were the other major problems faced by Rajanna.

Table 2: Major problems opined by the coconut climber

Sl. No.	Problems	Ranking
1	Not upgraded to the advanced climbing equipment due to high cost	I
2	Found difficulty and slippery while climbing straight trees	II
3	Not insured for occupational risk during climbing the tree	III
4	Need to change iron wire for about 6 to 8 months which requires huge cost	IV

The adoption of coconut tree climbing equipment has shown positive impact in the income and employment of the coconut tree climber. The equipment also help to reduce the physical strain and injuries which reduce the health cost of the tree climber. Further, coconut tree climbing efficiency has enhanced and thereby an increased income and year round employment is ensured. Coconut Development Board is taking necessary steps to conduct training programmes for rural unemployed youths in climbing in major coconut growing areas in Karnataka. The subsidy benefits and insurance coverage for coconut climbers may be popularized, so that more youths are attracted and choose coconut tree climbing as a profession.

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Kalpavruksha - God's gift

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Introduction

Coconut {*Coccos nucifera*}, kalpavruksha is God's gift to mankind, is a tree of abundance and is consumed to lead a sound, healthy and active life. It is indispensable in day today life from birth to death. In all religious and social functions its presence is very auspicious.

Cultivation and production

Coconut is a major and commercial crop grown in India, especially in southern states like Kerala which producing a major share of coconut in the country. Tamil Nadu, Karnataka, Odisha, Gujarat and Maharashtra also have emerged as leading states in coconut production. Other major producing countries are Indonesia, Philippines and Sri Lanka. Indonesia is the world leader in coconut production. Coconut is grown in 90 countries over 11 million hectares and 80 million people depend upon on coconut and its processing for their livelihood. India shares 15 percent of world area and produce about 25percent of world coconut production.

Scope

A lion's share of the production of coconut in India is consumed domestically for food preparation and extraction of oil and a very small quantity of coconut is exported to gulf countries. In the recent times, reduction is noticed in coconut production in India. It is because of the unforeseen fluctuations in climatic conditions, global warming, tsunami, floods, insects and pest attack etc. Also more area of coconut cultivated lands are often converted for other development and construction activities.

However the government has taken many steps to increase the area of coconut cultivation and diversification of production including schemes for introducing value added products to gain more profit to the farmers. Only selling coconuts is not going to benefit the farmers. What is needed is diversification of manufacturing value added materials to cater to various industrial applications and exports to fetch more profit and thereby improving the financial position of agriculturists and the nation as well. There is scope of preparing 60 by-products from coconut palm.

Propoganda on the ill effects of coconut was rejected by the experts and scientific community and it is proven that coconut oil is beneficial for maintaining human health. Professor Hegde has clarified that coconut oil is a functional food that gives to human body calories and increase health and life.

Coconut contains	
Protein	4.5%
Fat	41.8%
Carbohydrate	13%
Fiber	3.6%
Calcium	0.01%
Phosporus	0.24%
Iron	1.7%
Minerals	1.0%

The author had visited coconut farms of Andaman and surrounding areas and has collected physical characteristics of coconut in different islands near Port Blair which is biven below:

Value added products at a glance

More than 50 products are prepared from coconut palm.

A) From coconut kernel & coconut water

Tender coconut, Tender coconut water, Coconut juice, Neera, Toddy, Arac, Jaggary , Sugar, Coconut cream, Coconut butter, Coconut syrup, Coconut hammy, Coconut snowball, Chopra, Vinegar, Coconut oil, Vargin coconut oil, Roasted copra, Coconut milk, Coconut milk powder, Desiccated coconut powder, Coconut chips, coconut butter etc.

B) From coconut husk

Husk fiber, Husk coir, Husk mat, Husk brick, Geotextile (for preventing soil erosion), net, Bags, Rope, Manure etc.

C) From coconut wood

Crates, Wood, Furniture, Roof material, Arts and crafts, Fuel etc.

D) From coconut shell

Charcoal, Activated carbon, Shell powder, Art and handicraft etc.

E) From coconut leaves

Baskets, Hats, Shade, Roofing material, Brooms, Tooth sticks etc.

Applications

Virgin Coconut Oil (VCO) is very popular in USA and other western counties. They regularly take one teaspoon VCO as a tonic. It is reported to be good for lowering diabetics, control blood cholesterol, heart disease, blood pressure, boosts energy and aids in digestion.

Commercial coconut oil is widely used in all cooking medium. In spite of cheaper other oils available in the market, the manufacturer prefers coconut oil for producing various quality products. Hair oils, massage oils and baby oils are also prepared from coconut oil. It is also used in ayurvedic medicines. Coconut water is sweet and it is so natural and can replace synthetic soft drinks. Neera is a healthy and nutritious beverage gaining commercial importance. Coconut oil is also used in cosmetics and herbal oil preparation and aroma therapy. Vinegar prepared from coconut water is an excellent natural product for preparation of many products. Other coconut products like coco candies, biscuits and confectionary and chocolates are also marketed successfully.

Coconut oil is a source of many oleo-chemicals like fatty acids, glycerol, methyl esters, fatty alcohol, etc which is useful for many industrial applications.

Flavor and perfumery industries can contribute natural flavors and natural colors for the preparation of coconut products that may improve consumer acceptance and for more sale promotions and development. The natural flavors and natural colors adding in the products will definitely improve the export of coconut products.

Conclusion

Various central and state research organizations and agricultural departments are conducting research works on coconut. Proper coordination and cooperation between such organizations is required for achieving better results which will save the beneficiaries to get the fruits at the earliest. ■

56th ICC Session and Ministerial Meeting

The 56th ICC Session and Ministerial Meeting of the International Coconut Community was held virtually during 24th and 26th November 2020.

The Session/Ministerial Meeting was hosted by Samoa and was formally inaugurated by Hon. Tuilaepa Dr. Sailele Malielegao, Prime Minister of Samoa. The official proceedings were chaired by Hon. Lopaoo Natanielu Mua, Minister of Agriculture and Fisheries, Government of Samoa, who is also the current Chairman of ICC. Hon. John Simon, M.P., Minister of Agriculture & Livestock, Papua New Guinea, Plenipotentiary Delegates from the ICC member countries and representatives from observer organisations participated in the Session.

Smt. G. Jayalakshmi IAS, Chairperson and Shri. Saradindu Das, Chief Coconut Development Officer of Coconut Development Board attended the 56th ICC Session & Ministerial Meeting.

The country statement on the status of coconut sector development in India was presented by Smt. G. Jayalakshmi, Chairperson CDB. Delegates from the member countries of Federated States of Micronesia, Fiji, Guyana, Indonesia, Jamaica, Kenya, Kiribati, Malaysia, Papua New Guinea, the Philippines, Samoa, Solomon Islands, Sri Lanka, Thailand, Tonga and Timor Leste also presented their developmental programmes which provided a platform for sharing of ideas and concepts. Following this, the Technical Working Group and the Scientific Advisory Committee on Health of ICC presented on their activities undertaken which provided an insight into prospects and potentail for collaborative efforts by member countries , for the sustained development of the sector.

Dr. Fabian Dayrit, Chair of ICC Scientific Advisory Committee on Nutrition & Health, presented the programs and activities of the SACH in detail: the Continuing Threats on Coconut Oil: the different studies conducted on this was presented by citing the reference; updates on the use of VCO vs. COVID-19 and the result. The Committee also proposed follow-up actions and strategies suggested: follow-up the aborted FAO meeting, request for meeting with WHO, expand the membership of expert committees of FAO and WHO to include representatives from developing countries, strengthen links of national coconut agency with the health ministry, international research projects using similar protocols, propose VCO as a functional food etc.

Dr. Ponciano A Batugal, Chair, ICC Technical Working Group presented the Strategic Plan of ICC; programs and Projects status of different major coconut growing member countries; the ICC priority projects, which directly resulted in benefits of the farmers; potential collaboration with member countries, Coconut Coalitions and Alliances. The Session also endorsed the TWG priority projects to be implemented in all the ICC member countries.

COGENT being one of the major programs under ICC, Mr. Vincent Johnson, Interim COGENT Coordinator presented Report & Plan of Activities of

International Coconut Genetic Resources Network (ICC-COGENT); new Steering Committee members; four ITAGs and the ACIAR /DFAT fund in detail; including proposed ITAG research projects.

Representatives from observer organisations viz., CICY(Mexico), ACIAR(Australia), ITC(Geneva), CSIRO(Australia), CABI(London), NAM CSSTC(Indonesia) and CARDI(Caribbean islands).

The Annual Report of ICC was presented by Dr. Jelfina C. Alouw, Executive Director, ICC and the activities of COGENT was presented by the interim COGENT Coordinator.

The major international programmes proposed by ICC for coconut sector development in 2021 include the COCOTECH conference in Malaysia in September 2021, Integrated Pest Management Symposium in the Philippines and the International Certificate Course for coconut development in Sri Lanka. The extension of tenure of the Assistant Director and the proposed amendment of the ICC staff regulations were approved by the Session.

The audited statement of accounts of ICC for the year 2019 and the proposed budget for the year 2020 were presented along with the computations on the annual membership contributions from member countries which were approved by the Session. It was decided to hold the 57th ICC Session/Ministerial Meeting in Papua New Guinea in 2021.

The Technical Working Group Meeting of ICC was held prior to the ICC Session on 10.11.2020 which was attended by Shri. Saradindu Das, in which the programmes and projects for coconut sector development. The possibility of hosting the next ICC Tissue Culture Symposium in India came into discussion and ICC would be officailly communicating with India regarding the same. It is proposed that organising the ICC Symposium in India would provide an opportunity for the coconut development researchers, scientists and officials to get first hand information on the recent advances in tissue culture and mass multiplication of coconut across the globe and would be greatly beneficial to the coconut sector in India.

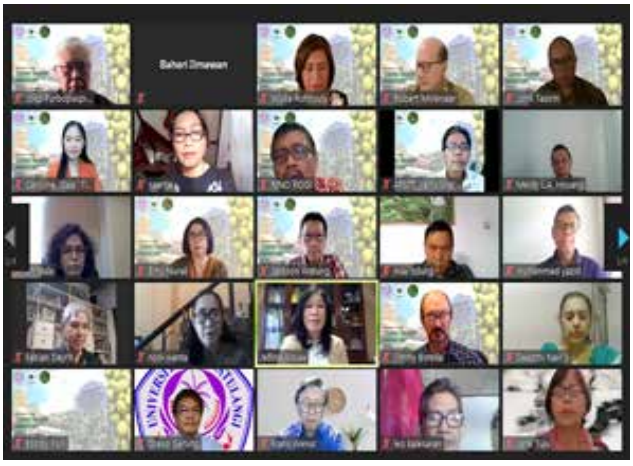
International Webinar on Coconut in Smart Agriculture

International Coconut Community in collaboration with Sam Ratulangi University, North Sulawesi convened an international webinar on the theme "Coconut in Smart Agriculture". More than 185 participants from the ICC member countries and other parts of the Globe from Asia, Australia, the Pacific, and Africa took part in the webinar.

In his opening remarks, Prof. Dr. Ir. Grevo. S. Gerung, Vice Rector of Academic Affairs, Sam Ratulangi University, addressed that in North Sulawesi Province coconut has become the main crop, contributing 60% of the non-oil and gas sector. The university is ready to collaborate with any institutions at National and International level, because knowledge is universal, belonging to all the institutions. He hoped the knowledge and experience shared in the webinar would create insights for all participants.

As keynote speaker, Dr. Jelfina C. Alouw Executive Director, ICC, presented "Global Scenario of Coconut Sector during COVID-19 Pandemic" which addressed the present situation: contribution of coconut and its products; coconut in smart agriculture, precision agriculture (or smart farming) can significantly boost the agriculture production both in terms of productivity and sustainability, in align with 9 of the 17 SDGs; global production, price and market/ export of coconut and its various products. She also presented the sustainability strategies. The outlook market for higher-value products is exceptionally positive, but low in the availability of raw material, so the strategies are innovative product development, diversification, quality including R&D expansion to face major challenges of coconut sector, including senility, pest/disease infestation, lack of investment in planting etc.

Dr. Fabian M. Dayrit, Professor Emeritus, Ateneo de Manila University, Philippines, and Chairman, ICC Scientific Advisory Committee on Health, presented "The Coconut: Treasure of the Tropics", which covered three main issues: the coconut is the fruit of the tropics, the coconut as the tree of life and prosperity, and the Coconut against COVID-19, in which he explained the origin of coconut, history of coconut, coconut cultivation and derivative products



as the tree of life and prosperity. He added the mechanism, how the VCO fights against the COVID-19 virus through its antiviral, immunomodulatory, and anti-inflammatory activities. He enlighted the results from clinical studies on COVID-19 cases, proved that VCO is an affordable, readily available, and healthy functional food. He shared the strategies against COVID-19 and solidarity studies of VCO, further R&D of VCO.

Mrs.Deepthi Nair S, Deputy Director, Coconut Development Board, Ministry of Agriculture and Farmers Welfare, Government of India, presented "Good Agriculture Practices in Coconut and Coconut Farmer Organizations in India". Sustainable agriculture must ensure social progress, economic growth, and environmental protection. She also explored the good agricultural practices which included seed development, productivity enhancement, soil health, conserve natural resources, micro irrigation, crop protection, crop diversification, extension and transfer of technology, insurance and credit, and mechanization. She outlined the concept of Farmer Producers Organization successfully framed in India and their role in the sustainable development of the coconut sector.

The International University, Vietnam National University presented "Coconut Cloning for Worldwide Replanting Urgency". He focused on the health-conscious lifestyle, increasing market demand for coconut products, which is the driving

force to the urgency. The possible solutions are rapid multiplication of varieties, through cultural tissue culture technology; embryo culture, haploid culture, somatic embryogenesis, and cryopreservation. Though there is still a challenge in the acclimatization automation by robot technology for subculture will reduce labor cost and time consumption for cloning.

Prof. Jimmy Botella, the University of Queensland, Brisbane, Australia presented Lethal Yellowing Disease in Coconuts: A Diagnostic Tool, and the Potential of Satellite-based Surveillance. He explained that monitoring was essential to control and eradicate the disease, involving surveillance to identify suspicious trees and confirmation to confirm/deny a disease. He introduced the use of drones and satellites to do the monitoring. He also introduced an innovative dipstick technology developed as a quick and straight forward tool for coconut Lethal Yellowing Disease (LYD) detection in the field and even the remote locations. The technology could extract DNA and RNA from living organisms is as little as 30 seconds without specialized equipment or personnel. The technology is trying in other crops like Cocoa and sugarcane besides coconut.

Dr. Joko Purbopuspito, Lecturer, Faculty Agriculture, Sam Ratulangi University, spoke on Soil Management for Coconut Smart Agriculture and mentioned that sustainable development is a development that meets the present needs of this generation without compromising the ability of future generations to meet their own needs. To achieve soil management for coconut smart agriculture, he introduced the acronym SMART: Specific - should follow climate and land/soils suitability's criteria protocol; Measurable - manages to pay attention to details and specific coconut requirements; Achievable - acquires all necessities for coconut rejuvenation in an organic way of life; Relevant - revolves and involves all Stakeholders in five pillars to proceed for consolidating, connecting, integrating and modernizing the coconut system; Time-bound - timely target oriented on the circular economy and added benefits.

In his closing remarks Prof. Ir. Robert Molenaar, Dean of Faculty of Agriculture, addressed that Indonesia has the largest coconut plantation in the world, but the productivity is only half of India. It is our challenge to increase the production. Smart technology is available to overcome problems in a smart way. Implementation of the smart strategy is the solution, such as synergetic efforts of the international coconut stakeholders, also multi-stakeholders' partnership where the Sam Ratulangi University and the ICC and many other institutions are involved. He hoped that the webinar could function as the drive to facilitate the development and relationship to real collaboration, a constant exchange of information and technologies regarding issues of coconut farming and development.There was an in-depth discussion on the topics, and the speakers addressed the queries. ■

Retirement

Shri. Sreekumar Poduval, Deputy Director, (Technology Development and Entrepreneurship) retired from the services of Coconut Development Board on 30th November 2020 on superannuation after serving the Board for more than 31 years. During his tenure he has steered the post harvest coconut processing sector to great heights and has given a new dimension to the coconut industry. He has been responsible for a series of development in the coconut processing sector. Under his leadership CDB had set up a full fledged Technology Development and Training Center and a modern NABL accredited Quality Testing Laboratory at South Vazhakulam Aluva, Kerala.

Health and Economic Benefits of VCO during COVID-19 and Beyond

International Coconut Community organised a Webinar on "Health and Economic Benefits of VCO during COVID-19 and Beyond" on 8th December 2020. This is in continuation of the agreement between the International Coconut Community (ICC) in collaboration with the Non-Aligned Movement Centre for South-South Technical Cooperation (NAM-CSSTC) in providing cooperative services to the member countries in research and development programs, capacity-building, technology transfer, under the theme: "Stay Healthy and Productive during Covid-19 Pandemic".

Representatives from ICC and NAM-CSSTC member countries from Asia, Australia, the Pacific, and Africa took part in the webinar.

Dr. Jelfina C. Alouw, Executive Director, in her welcome speech, addressed that the pandemic has restricted our mobility, but at the same time has triggered us to find ways to stay productive and has enabled scientists and medical doctors to reveal the coconut oil as an adjuvant against COVID-19. All member countries and national bodies are encouraged to do more studies to reveal more excellent potential of coconut oil and other coconut-based products to improve the previous findings and get more benefits. The diversification of coconut-derived products and value-addition help the small and marginal farmers who depend on coconut for their livelihood to realize a better return.

VCO has gained its popularity during early 2000 because of lauric acid's antimicrobial properties, the major fatty acids in VCO. Coconut oil has been endorsed by the World Dental Association as an antibiotic against tooth decay. The antibacterial activity of coconut oil takes on a special significance today when the number of antibiotic-resistance bacteria is rapidly increasing. VCO has anti-inflammatory, skin-protective activities, effective therapy for Alzheimer's, and most recently as an adjuvant against COVID-19. She hoped that the participants also come forward to consume, promote, and set up a VCO processing unit in their area as the source of functional food for their families and they can sell them as a source of income. We look forward to a global economic recovery from COVID-19 and sustainable coconut development.

Dr. Atmarita, MPH. Ph, Member of Expert Team, Indonesian Nutrition Association, presented "Health Benefits of VCO against COVID-19". She explained the composition, purity, and benefits of VCO. VCO had an antithrombotic effect, a significant beneficial impact on blood coagulation, which could help prevent cardiovascular diseases, has the same anti-inflammatory, analgesic, antipyretic, antioxidant, anti-stress, and antimicrobial properties.

Dr. Fabian M. Dayrit, Professor Emeritus, Ateneo de Manila University, Philippines, and Chairman, ICC Scientific Advisory Committee on Health, presented "Clinical Trial on the Impact of VCO as Adjuvant Against COVID-19", the beneficial effects of Virgin Oil and its characteristics. Dr. Toby explained the mechanism, how the VCO fights against the COVID-19 virus through its antiviral, immunomodulatory, and anti-inflammatory activities. He also presented the results from clinical studies on COVID-19 cases, proved that VCO is an affordable, readily available, and healthy functional food. Still, it needs further R & D to study whether VCO is effective in protecting persons with comorbidities and can improve the efficacy of vaccines.

Mr. Annas Ahmad, Marketing Manager, Vico

Oh My Coco - Provides useful life to coconut waste from large factories

Mariana Rodríguez, an engineer who works in a technology company, who loves to cook and prepare dishes in smoothie bowls, wanted to find a way to make them more sustainable and environmentally friendly."I was looking for an option that was totally ecological, that had a plus, that in addition to the fact that I liked it a lot, it will help the environment in a certain way and that is how I discovered this way of reusing coconuts, and I really liked it", says Mariana Rodríguez. This is how Oh My Coco was born two years ago, a Mexican company of sustainable utensils created with coconut waste. Mariana started with an investment of six thousand Mexican pesos ($ 279.92 at the exchange rate of October 8, 2020) and until today she has billed around one million pesos. From waste to utensils you could use for life. Among the Oh My Coco products are bowls, cutlery such as a knife, fork, spoons; straws, toothbrushes and others. The utensils of this company are recycled from waste from large companies that use coconut food or water as raw material and discard the shells that are considered as waste. "You help the environment because they are shells that were going to be discarded, that they were going to burn and we rescued them for a second use," explains Mariana. The entrepreneur says that with proper use and care, her items are durable and even if you no longer want to use them for eating, you can place the bowls, for example, in your garden and transform them into pots. Likewise, it ensures that its star products are the original bowl that is priced at 230 Mexican pesos and the zero waste kit with a price of 550 Mexican pesos. "We care that everything is sustainable, from the utensils to the packaging in which we deliver them, they are biodegradable boxes."Oh My Coco is found in more than 10 organic stores nationwide and in HEB, its products can also be purchased

on its official website , Amazon and Mercado Libre. Mariana says that her merchandise comes mainly from Vietnam since the factories with the most waste from this plant are located in that part of Asia, although her plans are to start working with waste from companies located in Mexico.At the moment, plans are to optimize online platform and continue to expand in ecommerce channels, since due to the pandemic it is the way through which can be made more sales. (Entrepreneur Asia Pacific

Source- The Cocommunity

Bagoes, presented Manufacturing & Marketing with Economic Benefits of VCO which explained the production and marketing process of VCO. The VCO can be processed by both dry and wet processes (fermentation or centrifuge). There are some concerns from the production aspect: taste and aroma, quality, certification, and cost-benefit analysis. The VCO market is rising, accelerated by the back-to-nature lifestyle trend, COVID-19, new research findings, and social media. There are more than 100 new brands founded in the market now. VCO still needs more development and innovation. Digital marketing could increase market awareness and promote the benefits of coconut oil.

In his closing remarks, Ambassador Diar Nurbintoro, Acting Director, NAM CSSTC, mentioned that the collaboration between NAM-CSSTC and ICC webinar and online training program commenced from September 2020 has gained positive responses from participants. The webinar has created a bridge that linked the agriculture and the health sectors. He hoped that the research on VCO against COVID-19 would inspire the coconut stakeholders to increase VCO production as a value-added product that will improve farmers' welfare, especially in the NAM-CSSTC and ICC member countries.

There was an in-depth discussion on the topics, and the speakers addressed the queries. The webinar was moderated by Mr. Vincent Johnson, Interim COGENT coordinator, ICC. ■

Cultivation Practices for Coconut - January

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

Shading

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

Irrigation

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

Removal of senile and unproductive coconut palms

Cut and remove senile and unproductive palms in the coconut garden and dispose them properly to maintain the field hygiene.

Management of pests and diseases

January month is the critical winter month with cool night and hot day. The humidity comes down and the Tamil calendar celebrates Pongal, with farmer's festival. Bountiful harvests in all crops are accomplished. Pest vigilance in this period should be strengthened as this period opens out dry day time with cool night favouring population build up of sucking pests and dry pathogens. Breeding pits of coconut rhinoceros beetle get dried favouring egg laying and development of grubs. The establishment

Pest-infested field

Black headed caterpillar

Goniozus nephantidis

of moth pests, viz., black headed caterpillar and slug caterpillar is aptly virulent and successful in this month in all endemic zones of Kerala, Tamil Nadu, Andhra Pradesh and Karnataka.

▶ *Black headed caterpillar, Opisina arenosella*

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

Management

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

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

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

d) Augmentative release of the larval parasitoids viz., Goniozus nephantidis (20 parasitoids per palm) and Bracon brevicornis(30 parasitoids per palm) if the pest stages is at third-instar larvae and above. The pre-pupal parasitoid (Elasmus nephantidis) and pupal parasitoid (Brachymeria nosatoi) are equally effective in pest suppression and are released at the rates of 49% and 32%, respectively for every 100 pre-pupae and pupae estimated.

e) Before releasing, the parasitoids are adequately fed with honey and exposed to host odours (gallery volatiles) for enhancing host searching ability.

f) Ensure adequate irrigation and recommended application of nutrients for improvement of palm health.

▶ *Nut borer, Cyclodes omma*

Incidence of nut boroer was observed in certain coconut gardens in Pollachi (Tamil Nadu). This is a sporadic pest normally found in dwarf genotypes and also in hybrids. Succulency due to excessive nutrition by nitrogenous fertilizers is also one of the factors responsible for pest outbreak. Caterpillars bore into buttons after pollination as well as immature nuts and feed on the internal contents during night hours, resulting in button shedding. Palms subjected

1. Nut boring caterpillar
2. Damaged buttons
3. Adult noctuid moth

Mite damaged nuts

Progression of mite damage

Mite colony

to assisted pollination are more susceptible to pest attack. The pupal stages are observed on the debris of palm crown.

Management

a) Crown cleaning and removal of immature stages of the pest

b) Judicious and need based application of nitrogenous fertilizers to avoid succulency

c) Application of the entomopathogen, Bacillus thuringiensis @ 20 g per litre or neem oil 0.5% (5 ml per litre with 10 g soap powder) using hand sprayers would reduce pest incidence.

▶ *Cocout eriophyid mite, Aceria guerreronis*

Coconut eriophyid mite is the invasive pest reported from our country during 1998 and has been on the rise during post-winter season. It belongs to the spider family with two pairs of legs, sub-microscopic (200-250 microns size), lays about 100-150 eggs and the life cycle completed in 7-10 days. Mites infests the developng nuts immediately after pollination and are confined within the floral bracts (tepals) and feeds on the meristematic tissues beneath the perianth. Appearance of elongated white streak below the perianth is the first visible symptom. Within few days, yellow halo appears round the perianth, which turns as warts and finally develops as cracks, cuts and gummosis. Shedding of buttons, immature nuts, malformation of nuts are other indications of mite damage.

Management

a) Removal and destruction of dried spathes, inflorescence parts and fallen nuts to subdue the pest population

b) Spraying 2% neem-garlic emulsion or azadirachtin 10000 ppm @0.004% or root feeding with neem formulation containing azadirachtin 10000 ppm at 10 ml with equal volume of water three times three times during March-April, October-November and December –January is recommended. Prophylactic application before the increase in summer temperature should be resorted to.

c) Application of talc-based preparation of acaropathogen, Hirsutella thompsonii@ 20 g / litre/ palm containing 1.6 x 108cfu three times in synergy with neem formulation.

d) Kalpaharitha (a selection from Kulasekharam Tall) was found field tolerant to mite damage.

e) Application of recommended dose of fertilizers, recycling of biomass, raising of green manure crops in palm basin and incorporation during flowering, summer irrigation including soil and water conservation measures improve the palm health and reduce the pest attack.

In the cyclone Gaja affected regions of Tamil Nadu and Titli affected regions of Andhra Pradesh, pest scouting for rhincoeros beetle and red palm weevil should be undertaken and all prophylatic strategies suggested should be undertaken.

Disease

▶ *Leaf blight of coconut (Lasiodiplodia theobromae)*

Leaf blight is an emerging disease in Coimbatore, Erode, Dindigul, Tirunelveli and Kanyakumari districts of Tamil Nadu. The pathogen causes damage in leaf and nuts. Affected leaflets start drying from the tip downwards and exhibit a charred or burnt appearance. The leaves in lower 3 to 4 whorls are affected. Leaf blight causes apical necrosis of lower leaves with an inverted “V” shape, and symptoms similar to those induced by drought (water deficit) and other stresses. The leaflets have extensive necrotic lesions with defined edges and without transition areas between the necrotic and healthy tissues. The pathogen can internally colonize the

rachis, inducing internal necrosis that moves upward towards the stem (systemic invasion). The necrotic tissues develop exposed cracks that release gums under the leaf rachis and at petiole insertion. On coconuts, small black sunken region appear near the perianth of immature nuts.When nearly mature /mature nuts were infected, the infection spread internally into mesocarp without any external symptoms. The affected nuts are desiccated, shrunk, deformed and drop prematurely causing 10% to 25 % loss in nut yield.

Management

a) Improving the palm health by application of 5 kg of neem cake enriched with Trichoderma harzianum and soil test based nutrition.

b) Adequate irrigation and adoption of soil and water conservation measures is advised.

c) Root feeding of hexaconazole @ 2% (100 ml solution per palm) thrice a year.

Root (wilt) disease

Root (wilt) disease (RWD) is prevalent in a contiguous manner in all the 8 southern districts of Kerala starting from Thiruvananthapuram to Thrissur and in isolated patches in the remaining 6 northern districts of the state. The disease is also prevalent in Coimbatore, Theni, Senkottai and Kanyakumari districts of Tamil Nadu. The presence of the disease has been recorded from Dakshina Kannada district of Karnataka and Goa as well.

The most obvious and diagnostic symptom of the disease is the abnormal inward bending of the leaflets termed ribbing or flaccidity. Yellowing and marginal necrosis of leaflets are the other characteristic foliar symptoms associated with the disease. Rotting of roots, shedding of immature nuts, drying up of spathes and necrosis of spikelets in unopened inflorescence is noticed in certain cases. The husk, kernel and oil of the nuts of the disease affected palms are of poor quality. Palms of all age groups are affected. The disease is non lethal, but debilitating. However, palms contracting the disease in the pre bearing age may not come to flowering and bearing. The disease also causes several internal changes in the palm.

A phloem bound mollicute – phytoplasma belonging to 16SrRNA group XI has been identified as the pathogen. The insect vectors transmitting the disease have been identified as lace bug (Stephanitis typica) and plant hopper (Proutista moesta). The coconut RWD has been found to occur on all soil types of Kerala under varying ecological conditions ranging from the high ranges of the Western Ghats to the coastal plains.

Management

One of the significant features of the disease is that it is not lethal but a debilitating malady which responds to ideal management practices. Two strategies, one for the heavily diseased contiguous area, and another for the mildly affected area have been formulated.

a. Strategy for heavily diseased tracts

In the heavily diseased area, the yield of palms can be sustained or even improved through adoption of integrated management practices:

- Removal of disease advanced and juvenile palms.
- Management of leaf rot disease.
- Balanced fertilizer application.
- Addition of organic manures.
- Raising of green manure crops in the basins and incorporation.
- Irrigation during summer months.
- Management of pests.
- Adopting inter and mixed cropping.
- Mixed farming in the diseased gardens involving raising of fodder crops in the inter spaces, maintaining milch cows and recycling of organic waste.

b. Strategy for mildly affected area

Removing all the diseased palms: The spread of the disease can be arrested by systematic surveillance and rouging of diseased palms as and when identified. Accurate and timely diagnosis of plant diseases is an essential component of integrated disease control.

ELISA test has been developed at CPCRI for the early diagnosis of this disease. The disease affected palms can be detected even 24 months before the expression of symptoms and they can be removed to avoid further spread.

Replanting with disease free healthy seedlings: Replanting with quality seedlings has to be undertaken only in gardens with sufficient space. As RWD is not amenable to conventional plant protection measures, cultivation of resistant varieties is the most ideal method for management. The resistant/tolerant varieties Kalparaksha (selection from Malayan Green Dwarf), Kalpasree (selection from Chowghat Green Dwarf) and the hybrid Kalpasankara (Chowghat Green Dwarf X West Coast Tall) released from Central Plantation Crops Research Institute (CPCRI) are suitable for cultivation in RWD endemic tracts

The dynamics of insect pests and diseases in coconut system vis-à-vis weather change pattern is so critical in population build up. Timely prophylactic measures to safeguard palms and enhancing palm health through need-based nutrition is very essential to withstand the pressure exerted by pests and diseases in outbreak situation. ■

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

Trainings offered by CDB Institute of Technology, Kerala

S.No.	Name of training programme	Duration	Fees	Topics/Products covered	Targeted participants	Minimum participants needed for a batch	Facilities offered
1	Coconut Convenience Foods-1 day- Demonstration only	1 Day	Rs.500/- per head	Coconut chips, Chocolate, Cookies, Lemonade (squash), Pickle- 5 products, Theory sessions on value addition, packaging & Hygiene.	Kudmbasree units, other Self Help Groups, FPOs(CPS, CPF,CPC), Individuals	5	Tea & snacks, Lunch
2	Coconut Convenience Foods-4 Days	4 Days	Rs.2000/- per head	Coconut chips, Chocolate, Cookies, Lemonade, Pickle, Chutney Powder, Coconut ladoo, Tender Coconut Spread, Coconut candy, Coconut Jelly, Virgin Coconut Oil(hot process)-Theory sessions on value addition, packaging& Hygiene.	Kudmbasree units, Individuals, Other Self Help Groups, FPOs	5	Tea & snacks , Lunch
3	Coconut Vinegar from coconut water by slow process/ Nata de coco.	1 Day	Rs.1000/- per head	Coconut Vinegar	Basic science knowledge Kudmbasree units, Individuals, other groups, FPOs	5	Tea & snacks, Lunch
4	Training on Chemical analysis.	1 week	Rs.2500/- per person	Chemical analysis of coconut products	Minimum qualification- Graduation in Chemistry/Biochemistry/ Food chemistry/Food Technology	1	Nil
5	Training on Microbiological analysis	2 weeks	Rs.5,000/- per person	Microbiological analysis	Minimum Qualification – Graduation in Microbiology/ other life sciences with microbiology as one of the subjects	1	Nil
6	Entrepreneurship Development Programme	5 days	NIL	Sessions on Entrepreneurship, value additon, Food safety, Quality aspects, Marketing strategies, Schemes of CDB etc.	Farmer groups/Self Help Groups etc.	20	Food & Accommodation

Market Review – November 2020

Domestic Price

Coconut Oil

During the month of November 2020 the price of coconut oil opened at Rs. 18500 per quintal at Kochi and Alappuzha market and Rs. 19500 per quintal at Kozhikode market. The price of coconut oil at Kochi,Alappuzha and Kozhikode market expressed an overall upward trend.

The price of coconut oil closed at Rs. 19700 per quintal at Kochi and Rs. 19600 per quintal at Alappuzha market and Rs. 21200 per quintal at Kozhikode market with a net gain of Rs.1200 at Kochi and Rs.1100 at Alappuzha and Rs.1700 per quintal at Kozhikode market.

The prices of coconut oil at Kangayam market in Tamilnadu, which opened at Rs. 17133 per quintal, and closed at Rs.18533 with a net gain of Rs. 1400 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
02.11.2020	18500	18500	19500	17133
07.11.2020	18800	18800	19700	17333
14.11.2020	18815	18800	19800	NR
21.11.2020	19200	19200	20300	17667
28.11.2020	19600	19400	21000	18467
30.11.2020	19700	19600	21200	18533

Milling copra

During the month, the price of milling copra opened at Rs.12600 per quintal at Kochi and Rs.12450 per quintal at Alappuzha market and Rs.12500 per quintal at Kozhikode market. The price of Copra at these three markets expressed an overall upward trend.

The prices closed at Rs.13000 per quintal at Kochi market and Rs.12950 per quintal at Alappuzha market and Rs.13800 per quintal at Kozhikode market with a net gain of Rs.400 and Rs.500 and Rs.1300 per quintal respectively.

**NR-Not reported *NQ-Not quoted*

At Kangayam market in Tamilnadu, the prices opened at Rs. 11100 per quintal and closed at Rs. 12200 per quintal with a net gain of Rs. 1100 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
02.11.2020	12600	12450	12500	11100
07.11.2020	12600	12450	12650	11200
14.11.2020	12615	12450	12750	NR
21.11.2020	12800	12750	13200	11900
28.11.2020	12900	12850	13700	12100
30.11.2020	13000	12950	13800	12200

Edible copra

The price of Rajpur copra at Kozhikode market opened at Rs. 15000 per quintal expressed an upward trend during the month and closed at Rs.17500 per quintal with a net gain of Rs.2500 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
02.11.2020	15000
07.11.2020	14000
14.11.2020	14500
21.11.2020	15800
28.11.2020	18500
30.11.2020	17500

Ball copra

During the first week of the month the price of ball copra at Tiptur market reported was Rs. 12300 per quintal. No report was received from Tiptur market during the last week of the month.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
02.11.2020	12300
07.11.2020	NR
14.11.2020	NR
21.11.2020	12600
28.11.2020	NR
30.11.2020	NR

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.12700 per quintal and expressed an upward trend during the month. The prices closed at Rs.13450 per quintal with a net gain of Rs.750 per quintal during the month.

Weekly price of Dry Coconut at Kozhikode market (Rs/ Quintal)	
02.11.2020	12700
07.11.2020	12300
14.11.2020	12600
21.11.2020	13200
28.11.2020	13450
30.11.2020	13450

Coconut

At Nedumangad market in Kerala, the price of partially dehusked coconut opened and closed at the same price.

At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.17000 per thousand nuts and closed at Rs. 18000 during the month with a net gain of Rs. 1000 per thousand nuts.

At Bangalore market in Karnataka, the price of coconut opened at Rs.22500 per thousand nuts

Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Pollachi	Banglore
02.11.2020	20000	17000	22500
07.11.2020	20000	17000	17500
14.11.2020	20000	NR	NR
21.11.2020	20000	17000	20000
28.11.2020	20000	18000	20000
30.11.2020	20000	18000	NR

International price

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
07.11.2020	174	246	NR	517
14.11.2020	173	246	NR	NR
21.11.2020	178	246	NR	530
28.11.2020	182	248	NR	557
				*Pollachi market

Coconut Oil

International price of coconut oil in Philippines domestic price of Sri Lanka and India expressed an upward trend during the month.

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

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
07.11.2020	1272	NR	1217	2494	2356
14.11.2020	1333	NR	1287	2519	NR
21.11.2020	1479	NR	1411	2566	2401
28.11.2020	1435	NR	1361	NQ	2510
					* Kangayam

Copra

The domestic price of copra in Philippines and India expressed an overall upward trend.The price of copra quoted at different domestic markets are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
07.11.2020	766	723	1409	1522
14.11.2020	810	776	1391	NR
21.11.2020	907	839	1405	1618
28.11.2020	909	808	NR	1645

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