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Indian agriculture blooms beyond expectations: Shri Narendra Singh Tomar

Occurrence and status of exotic whiteflies in coconut ecosystem and their management

Coconut planting and after care

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Phone	:	0484- 2377266, 2377267, 2376553, 2375266, 2376265
Fax	:	91 - 0484-2377902,
Grams	:	KERABOARD
E-mail	:	kochi.cdb@gov.in
Website	:	www.coconutboard.gov.in

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Coconut Development Board

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

Functions

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

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

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

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Message

Dear Readers,

Over the last few decades, we have witnessed massive technological developments in the world which has transformed the lives of people. But these opportunities have not had significant impact on the agricultural sector. Information and Communication technologies can play a key role in knowledge exchange among the farmers and the various stakeholders along the agriculture value chain. It can also provide targeted recommendations, market integration and access to finance to make agriculture a profitable enterprise and attractive to the youth. It is in this context that the Government has announced support for digital and high tech services to farmers in the Union Budget for the financial year 2022-23. Kisan Drones were proposed for crop assessment, digitization of land records and for spraying of insecticides and nutrients.

Application of drones in farming covers many broad areas like agricultural field soil analysis, wide spread seed planting, crop health monitoring and surveillance, spraying of inputs, irrigation and monitoring, crop damage assessment and livestock tracking. It is possible to generate 2D and 3D maps through early soil analysis which is useful in planning crops. After planting, drone driven soil analysis provides data for irrigation and nitrogen and other nutrient level management. Soil organic carbon maps can be produced through air borne sensors. Variable Nitrogen stress mapping is possible using drone based multi and hyper-spectral sensors. In the case of crop health monitoring and surveillance, it is found that drones can show the precise development of a crop and reveal production inefficiencies enabling better crop management. Drones with hyper spectral, multispectral or thermal sensors can even identify the dry parts in a field. Discrimination and classification of horticultural crops can also be undertaken using airborne imaging. For instance, air borne imaging of a coconut plantation with coconut based high density multi-cropping system is possible. Regarding spraying of inputs, drones can undertake spraying with enhanced coverage, increased chemical effectiveness, faster and easier spraying. They can also follow pre-mapped routes to spray crops and also cover areas with difficult access for tractors and aircraft. Crop damage assessment is also possible through identification of change in health.

Increased integration of digital technology in agriculture will support in better, faster and cheaper delivery of services and provide scalable, lower cost tailor made solutions to suit specific needs of the farmers thereby leading to increased productivity and reduced expenses making the sector competitive in the domestic and global markets thus attaining the overall objective of doubling farmers income.

Let us look forward with hope to the day when digital agriculture leads the pathway to prosperity.

Editor

Indian agriculture blooms beyond expectations

Narendra Singh Tomar,
Union Agriculture Minister, Government of India

Under the leadership of our popular and visionary Prime Minister Shri Narendra Modi, the nation is reaping a bountiful harvest of all-round efforts made by the Union Ministry of Agriculture and Farmers Welfare in the last eight years. Several innovative initiatives taken by the Ministry in the form of schemes and programmes, in order to ensure the commitment and accountability of the government, have resulted in ushering sweeping reforms in the direction and state of farmers and farming across the country. The livelihood standards of the farmers are improving and agricultural finances provided by the Centre are reaching them directly through bank accounts with complete transparency. The income of farmers has risen in various aspects and a new wave is visible as agriculture has emerged as a viable business proposition. Government's schemes, programmes and all other activities have always been focussed towards this effort to empower farmers become agricultural entrepreneurs.

In the last eight years, the budget allocation of the Ministry of Agriculture and Farmers Welfare has been continuously hiked and several schemes was rolled out with an aim to make agriculture sector farmer-friendly. The allocation of agriculture budget in the current financial year to about Rs 1.32 lakh crore is a reflection of the devotion of the central government towards the welfare of farmers. The budget allocation for agriculture has increased by almost six times in the last eight years. The journey of development in the agriculture sector does not end here. Besides increased allocation, the record production of food grains and horticultural crops is also a proof of the budget allocation being spent in the right direction. According to the Third Advance Estimates for the year 2021-22, the production of

food grains is estimated at about 315 million tonnes, while the production of the horticulture sector is also estimated at 334 million tonnes, which is the highest ever.

Indeed, it is no small matter that in the midst of the challenges of the Covid pandemic, India has supplied food grains to many needy countries and even during the Russia-Ukraine crisis, India has once again emerged as a major source of food grains supply to the world. Not only is the production of food grains showing a steady increase in the country at a record level, but the exports of agriculture produce is also rising continuously, which has reached almost Rs. four lakh crore.

Keeping in mind the better remuneration to farmers and their livelihood, the government has continuously increased the Minimum Support Price for Kharif, Rabi and other commercial crops. As a result the MSP of paddy rose to Rs. 1940 per quintal from Rs. 1310 per quintal in 2013-14.Similarly, in the year 2013-14, the MSP of wheat was Rs. 1400 per quintal, which has now rasied to Rs.2015 per quintal.

During 2021-22 (Rabi Marketing Season (RMS), 433.44 lakh MT of wheat was procured by the government at MSP, which is the highest ever. Punjab, Uttar Pradesh, Rajasthan, Uttarakhand, Gujarat, Himachal Pradesh and Jammu and Kashmir have seen the highest procurement of wheat so far. The success story does not close here. Data also reveals that a sum of Rs 85,604.40 crore was credited to 49.19 lakh wheat producing farmers during the RMS directly into their bank accounts in a transparent manner.

Continuing its commitment towards the farmers, the government has credited around Rs 1.82 lakh crore to about 11.5 crore farmers directly into their bank accounts under the Pradhan Mantri Kisan Samman Yojana (Total Rs.6,000 per annum in three equal instalments). This scheme is one of the most comprehensive and key schemes of the Central Government and also a symbol of devotion to farmers, in which there is no role for middlemen.

Fulfilling the government's sincere efforts towards improving soil health, the Soil Health Card has been provided to crores of farmers. Keeping in mind the soil health, this scheme is making farmers aware of effective and better farming techniques to get better yield.

Under the guidance of Prime Minister Shri Modi, the Government has made special provision for Organic Farming as well as Natural Farming in this year's general budget. Under this, special attention is paid to soil health with an objective of increasing farmers' income through natural farming and conservation of resources and environment. In Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal, works will be undertaken to bring an area of five km on both banks of the Ganges river under the Natural Farming through a comprehensive action plan.

The vision of the government to promote natural farming does not stop here. The government has constituted a committee under the Indian Council of Agricultural Research (ICAR) to include syllabus related to natural farming in undergraduate and postgraduate teaching courses, and chemical-free natural farming is being supported by the ministry and ICAR. Keeping in view the contemporary nature of natural farming, ICAR has issued special guidelines to agricultural universities to include research and allied subjects related to natural farming. Natural farming has been able to increase the income of the farmers and is a symbol of the novel thinking of the Central Government towards ensuring better living.

Besides various schemes and programmes, the dedication of the union government towards the farmers is also reflected in the Rs. 1,00,000 crore allocated for the Agricultural Infrastructure Fund and the government is committed to provide basic facilities like Godowns, Custom Hiring Centres, Primary Processing Units, Sorting and Grading Units and Cold storage. Through these basic facilities, the Government Is committed to provide remunerative prices to farmers for their produce.

In this series, the government, under the Aatma Nirbhar Bharat Abhiyan (Self-Reliant India Campaign) is also giving special promotion to the National Beekeeping and Honey Mission. Similarly, through platforms and schemes like the National Agricultural Market (e-NAM), Pradhan Mantri Krishi

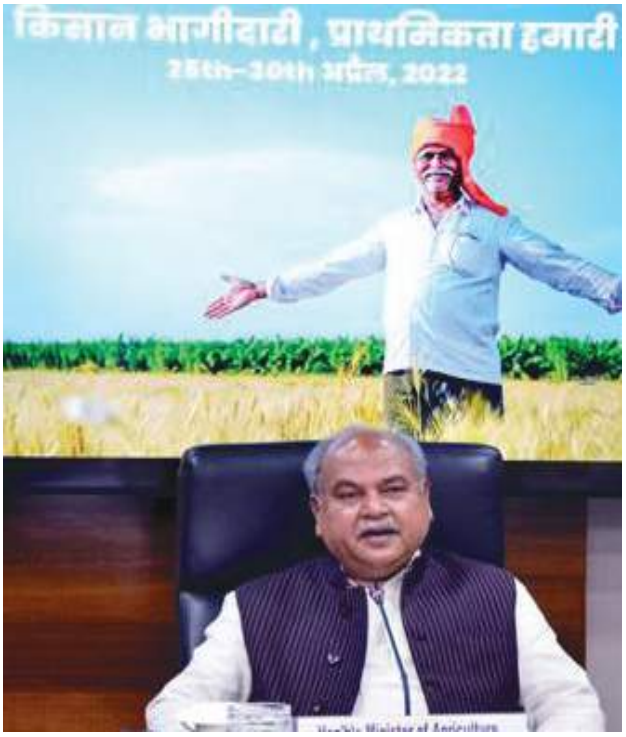
Sinchai Yojana, Agricultural Mechanization and Cluster Development Programme under MIDH, the government is committed to provide maximum benefits to the farmers.

Under the Pradhan Mantri Fasal Bima Yojana, farmers have been provided with insurance cover in the event of a natural calamity. In order to bring more and more farmers under the crop insurance scheme, the "Meri Policy, Mere Haath" campaign has been launched. The importance of PM Crop Insurance Scheme can be gauged from the fact that farmers have deposited about Rs.21,000 crores of premium. while they have been reimbursed Rs 1.15 lakh crore as claims against crop damage.

Kisan Rail Scheme is another very important concept of PM Shri Modi for faster transportation of agricultural produce, under which special trains are being run for the swift movement of perishable agricultural produce. This is a major illustration of the

government's commitment and credibility towards the farmers. The success of Kisan Rail can be gauged from the fact that so far about 2,500 train trips have been conducted on about 175 routes across the country.

This year's budget of the Ministry of Agriculture has given special emphasis on agriculture Startups and agri-entrepreneurship. Work is being done very fast in this direction, and the results are also visible. Through the farmer friendly schemes of the Government of India, it is high time our agriculture sector scales new highs. Many hopes and expectations rest on the agriculture sector, which the government under the leadership of our generous and able Prime Minister Shri Modi understands well and is chugging full steam towards reaching its destination.



The government, along with the public, was celebrating the 'Azadika Amrit Mahotsav' all over the country. All the ministries and departments of the Centre, state governments and their organizations were mobilized in celebrating this grand festival. In its continuation, the Union Ministry of Agriculture and Farmers Welfare, showing dedication towards farmers, celebrated 'Kisan Bhagidari, Prathmikta Hamari Abhiyan' with great enthusiasm from 25th to 30th April 2022. During this campaign, all the Departments of the Ministry of Agriculture, organizations and institutions under it including the Indian Council of Agricultural Research and about 725 Krishi Vigyan Kendras (KVKs) spread across the country organized Kisan Melas, Kisan Sammelans, seminars, workshops, webinars, round tables etc., in which a lot of union and state ministers and other public representatives including MPs and MLAs participated enthusiastically. In this way, when the nation celebrates the 100th Year of Independence, then the country will have a bird's eye view of the evergreen agricultural sector of the Incomparable India. With this dream, we are all moving towards building an AatmaNirbhar Agriculture – Aatma Nirbhar India (Self-Reliant Agriculture - Self-Reliant India).

Courtesy: Press Information Bureau, Ministry of Information and Broadcasting, New Delhi ■

Occurrence and status of exotic whiteflies in coconut ecosystem and their management

M Saranya[1], K Selvaraj[2], T. Srinivasan[3] and PS Shanmugam[3]

[1,3]Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore-641003

[2]ICAR- National Bureau of Agricultural Insect Resources, Bengaluru-560024

Introduction

Coconut, *Cocos nucifera L.* (Arecaceae) is a major plantation crop grown in south India. Coconut is also called the King of Species or Tree of Heaven or Kalpavriksha or Tree of life. Coconut is originated from South East Asia and it is widely cultivated in all the tropical regions of the world, growing particularly well in coastal areas. Small and marginal farmers depend on coconut directly or indirectly for their livelihood. India is the third-largest producer of coconut after Indonesia and the Philippines, with a share of about 19.20% (NABARD, 2016). In India, southern states viz., Tamil Nadu, Kerala, Karnataka and Andhra Pradesh are the leading states in coconut production which account for more than 90% of the total coconut production of the country.

Cococnut is grown on 2.17 million ha producing 21,384.33 million nuts per year with average productivity of 9,815 nuts /ha (www.indiastat.com. 2018-2019). Out of the total production of coconuts in the country, about 50% is used as mature nuts, 35% is used for copra and 15% is consumed in the tender form for drinking purposes. Coir from the coconut palm is a versatile fiber and helps in the upliftment of livelihood of rural women by generating employment. Coconut is mainly produced for the oil cause and India has unbeatable quality in coconut oil production.

More than 900 species of insect pests, including Coleopteran, Lepidopteran, and Hemipterans, cause substantial economic damage to coconut. Of which, coconut eriophid mite, *Aceria guerreronis Keifer* (Eriophyidae: Acari), rhinoceros beetle, *Oryctes rhinoceros L* (*Coleoptera: Scarabaieidae*), red palm weevil, *Rhynchophorus ferrugineus Olivier (Coleoptera: Curculionidae)*, black-headed

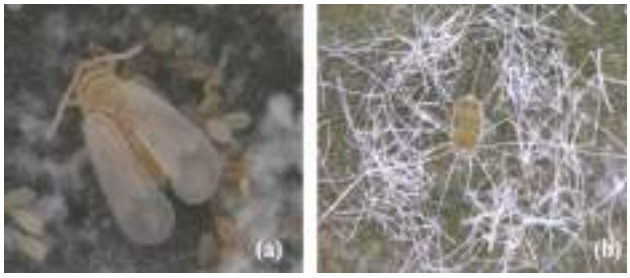
*Corresponding author: suganpraveen9@gmail.com

Spiralling whitefly,
Aleurodicus dispersus

Rugose Spiralling whitefly,
Aleurodicus rugioperculatus

Bondar's Nesting Whitefly,
Paraleyrodes bondari

Neotropical whitefly,
Aleurotrachelus atratus



Nesting whitefly, Paraleyrodes minei laccarino (PC: Selvaraj et al., 2021)

caterpillar, *Opisina arenosella Walker (Lepidoptera: Oecophoridae)* and white-grub, *Leucopholis coneophora Burmeister (Coleoptera: Scarabaieidae)* are considered as the major pests of coconut. Most species of beetles feed on leaves, roots, or bores in plant buds resulting in the loss of fronds and damage to palms. Lepidopterans are major devastating pests of coconut, mainly feeding on leaves and inflorescence. The coconut mite, *Aceria guerreronis Keifer* damages immature nuts causing serious yield losses and two whitefly species viz., areca nut whitefly, *Aleurocanthus arecae* and spiralling whitefly, *Aleurodicus dispersusare* considered as minor pests.

Occurrence of invasive whiteflies in coconut and their coexistence

Whiteflies are devasting phloem feeder of agricultural, horticultural and forestry ecosystem. Mandal (2011) recorded 116 exotic insect species in India. Sundararaj et al. (2020)enlisted 476 species of whiteflies under 67 genera from India, which comprises of five species under two genera in the subfamily Aleurodicinae Quaintance & Baker and 449 species under 64 genera in the subfamily *Aleyrodinae Westwood.* In India, so far, six species viz., *Aleurocanthus arecae, Aleurodicus dispersus, Aleurodicus rugioperculatus, Aleurotrachelus atratus, Paraleyrodes bondari* and *P. Minei* are known to infest coconut (Selvaraj et al., 2019). All these whiteflies are invasive except *A. arecae*, accidentally invaded along with their host plant and frequent distribution in different parts of the world due to plant trade, the small size, cryptic nature and immature stages being attached to the host-plant.

Exotic whiteflies with similar habits co-exist in more or less the same niche in coconut palm and have a similar pattern of growth and development. *Aleurodicus rugioperculatus, P. bondari, A. dispersus* and *P. minei* were found to co-exist on many of the host plants including coconut palms. It was observed that *A. rugioperculatusis* co-exist with *A. atratus, P. bondari, A. dispersus* and *P. minei* on coconut. Infestations of *A. atratus* and *A. rugioperculatus* along with native whitefly, Aleurocanthusarecae, commonly observed on coconut.

▶ 1. Spiralling whitefly, Aleurodicus dispersus Russell

Spiralling whitefly, *Aleurodicus dispersus* is native to the Central America and in India. It was first reported in 1993 in Kerala. Female whitefly lays elliptical, smooth surfaced yellowish white eggs in a typical spiral manner. There are four nymphal instars, which are greenish, white and oval and total nymphal duration lasts for 13-14 days. Fourth instar nymphs (pupae) are covered with heavy white wax materials. The total nymphal period is normally for 12 to 14 days and pupal period about 2 to 3 days. Development from egg to adult takes around 18 to 29.66 days. Adults are larger (1.74 mm), coated with a fine dust like waxy secretion and fore wings with characteristic dark spots which live for 13 to 22 days. Nymphs and adults are congregate generally seen on the lower surface of leaves and secrete copious white, waxy flocculent materials which are readily spread elsewhere by wind and create a very unsightly nuisance. Sucking the cell sap by nymphs and adults which depletes nutrients and water from affected host plants and causes premature drying under severe infestation. Sticky honeydew is excreted which serves as a substrate for dense growth of sooty mould which may interfere with normal photosynthesis of affected plants and reduction yield parameters.

▶ 2. Rugose spiralling whitefly, Aleurodicus rugioperculatus Martin

Rugose Spiralling Whitefly (RSW), *Aleurodicus rugioperculatus* was originated from Central America and in India it was first observed in the coconut palms of the Pollachi area of Tamil Nadu and Palakkad area of Kerala during July-August 2016. Per cent infestation of RSW was recorded in coconut at 40-60% and banana leaves at 25-40% (Selvarajet al., 2017a). Rugose spiralling whitefly sucks the phloem sap from plants. It is stressful, defoliating plants and disrupting photosynthesis. Thus, RSW indirectly affects the quality of nuts by producing white waxy material and a copious amount of honeydew leading to sooty mould fungus growth and contributes to a reduction in photosynthesis of the palms thus, indirectly affecting the quality of nuts. Nymphs are golden yellow in colour and its body covered with white dense waxy material. Adult have three dark brown spots on both wings and males have pincer like structure at abdomen. It takes 35-49 days to complete the entire lifecycle from egg to adult stage. Summer season is very favorable to maximize its progeny(Selvarajet al., 2021).

▶ 3. Bondar's Nesting Whitefly, Paraleyrodes bondari Peracchi

Bondar's nesting whitefly was first observed in coconut farms of Kerala during 2018 and it was originated from Neotropical region. Life stages were confined to the lower surface of coconut leaflets. Adults are smaller than *A. rugioperculatus* and it constructs nests with densely woven, irregular layer of fiberglass-like woolly wax strands. Yellowish stalked eggs in clusters in the woolly wax nest without wax covering. Body of the nymph is covered with a band of white wax and surrounded by short setae. Adult whiteflies have two oblique grey bands occur on each forewing, and converge toward the midline such that it appears to form an "X"-pattern. Total life span including adult longevity is 32 –34 days. The feeding damage of *P. bondari* is not severe like *A. rugioperculatus* with reduced honey dew excretion and sooty mould fungal growth.

▶ 4. Nesting whitefly, Paraleyrodes minei Iaccarino

Nesting Whitefly was first observed in coconut farms of Kerala during 2018 and it is originated from neotropical region. Female adults construct loosely woven, woolly wax nest. Eggs are cream-coloured laid in clusters with short stalks on the lower surface of leaflets bending inwards towards the leaf surface. The emerging mobile crawlers are creamish, sub-elliptical with flocculent wax on the dorsum extending from thorax to abdomen. The crawlers shed their appendages, remain fixed, and become flat and creamish, producing a fringe of short hyaline wax rods rising from the dorsum with fibreglass-like wax rods. Female adults have broad and swollen abdomen with well-developed wax plates, whereas in male abdomen is narrow becoming pointed at the apex and the wax glands are not well developed. Adults are with dull yellow body with whitefly wings without any marking and spread wings wider. Total life cycle span including adult longevity is 31-32 days.

▶ 5. Palm infesting whitefly, Aleurotrachelus atratus Hempel

Aleurotrachelus atratus is a Neotropical whitefly, originated from Brazil. In 2019, it was first reported in coconut and ornamental palms during 2019 in Mandya district of Karnataka.Clustered creamy white stalked eggs are in semicircular pattern. The first instars are initially transparent black and have four pairs of wax plumes on dorsal surface excreted by glands at the base of dorsal setae. Each dorsal seta has curving longitudinal grooves that guide the wax flakes as they are secreted from the setal base and all the nympal instars are black in colour. Puparia are elliptical, black, 1.0-1.1 mm long with a long marginal white wax fringe and dorsal wax filaments that often completely cover the pupae. Adults differ from the other invasive whiteflies infesting palms; smaller than *A. rugioperculatus* but larger than *P. bondari* and P. minei and without any wavy marking on the wings. Total life span is about 54-59 days in Karnataka.

Integrated Pest Management strategies for invasive whiteflies

Biological control of these invasive whiteflies through naturally occurring insect predators and parasitoids which are economically feasible and ecologically compatible. Potential natural enemy, *Encarsia guadeloupae* and *E. dispersa (Hymenoptera: Aphelinidae)* were found to reduce the severe economic lossof *A. dispersus* and *A. rugioperculatus.* Avoiding application of synthetic pesticides to conserve natural enemies viz., Cybocephalus spp., Cryptolaemus montrouzieri,*Chilocorus nigrita*, *Menochilussexmaculatus*, *Curinus coeruleus, Mallada astur, Mallada boninensis* and *Chrysoperla zastrowisillemi* (preying mantis, spiders and nymphal parasitoid *Encarsia guadeloupae* and *E. dispersa*

of *A. rugioperculatus* and *A. dispersus* can be done.

Grow banana and Indian shots plants as banker plants in coconut garden as intercrop or border crops for conservation and augmentation of natural enemies to prevent severe pest outbreaks.Yellow sticky trap is an important plant protection measure for the monitoring of whiteflies (Uthamasamy et al., 1990). Whitefly adults are more attracted to yellow colour. Tying yellow polythene sheets (3 x 1 ft or 5 x 1.5 ft) smeared with castor oil at 5-6 ft height on the coconut tree to attract the whitefly adults can be done. Place yellow sticky trap 8 numbers per acre. Smear grease or castor oil once in three days on a yellow polythene sheet. Banding of coconut trunk with yellow sticky polythene sheet can also be done.

Forced water-spray need to be done underside of coconut leaflets to dislodge the whiteflies to arrest its reproduction wherever water availability is not a constraint. Rugose spiralling whitefly has the capacity to produce an enormous amount of honeydew secretion which leads to sooty mould growth. It indirectly affects the photosynthesis of the plant. For this 1% starch solution is recommended for removing the sooty molds adhered on coconut leaflets. For preparing 1% starch solution, boil 1 kg of maida in 5 litres of water and mix it in 20 litres of water for spraying.

Conclusion

The invasive whitefly species can maximize their progenies in a short time, exhibit high phenotypic plasticity, and have a strong potential to compete with native species and cause damage to economically important crop plants.Indiscriminate use of insecticides causes resistance and resurgence problem in the management of invasive whiteflies. All the above invasive species are polyphagous and absence of natural enemies in the introduced area favour host spread. There is urgent need to survey and document the natural enemies of *P. bondari, P. minei, A. floccosus* and A. atratus, and evaluate potential candidates for their introduction from their native countries to India for the development of efficient biocontrol management strategies.

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Coconut Chips

Coconut chips is a ready-to-eat snack food. It is prepared in salted and sweetened forms. The Central Plantation Crops Research Institute, Kasaragod has standardized the process for preparation of chips. Coconuts of 9-10 months are used for the preparation of chips.

Installed Capacity - 10000 nuts/day

Investment - Rs. 35 lakhs

IRR - 22 %

Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Composition of Coconut Chips

Sl. No	Parameters	per 20 g
1	Fat	9.42g
2	Lauric acid	4.82g
3	Calcium	2.10mg
4	Fiber	1.93g
5	Iron	1.30mg
6	Cholesterol	0.00

Coconut based integrated farming system (CBIFS)

for profitability and sustainability of coconut production system

P. Muralidharan and S. Ravi
ICAR-Krishi Vigyan Kendra- Alappuzha
ICAR-CPCRI, Regional Station, Kayamkulam, Kerala

Coconut, also known as 'Kalpavriksha' or 'Tree of heaven', provides livelihood security to millions of people across the world through nutrition, employment, enterprises and eventually income generation. In India, the crop supports the livelihood of more than twelve million people across 18 states and 3 union territories. 90% of the cultivation is confined to the South Indian states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. As per records, more than 90% of the coconut holdings are less than 0.4 ha, revealing that coconut cultivation in the country is in the hands of small and marginal farmers. Even though occupying the largest area (34.75%) and contributing to 32.9% of the total national production, the situation in Kerala is of further concern as the small holdings neither provide enough employment opportunities to the family throughout the year nor generate sufficient income to depend on the system alone. The uncertainties owing to high degree of price fluctuations, lack of concrete mechanisms for procurement, and inadequate infrastructural arrangements for value addition altogether contribute to the reduction in dependency on the crop in addition to the difficulties in management for optimum production.

Unlike many other plantation crops, coconut is amenable to different farming system models including intercropping, multi-storied cropping and mixed farming systems. The unique plant architecture of the crop offers enough scope for utilization of the natural resources like soil, water and sunlight in the garden through accommodating other crops, poultry and animals in almost 75% of the unutilized area between trees and hence forms an ideal situation for an integrated farming system. Kerala's coastal belt which is relatively flat, and heavily crisscrossed by a network of interconnected canals and rivers offers high scope for the groves of coconut trees to be integrated with different production systems like paddy, banana, vegetables, spices and tuber crops along with animal husbandry, poultry rearing and fisheries activities. With high population density and minimum per capita land holding size, intensification of agricultural activities is a must in the coastal belt for deriving a decent income for livelihood of the farmers. Thus Coconut

Based Integrated Farming System (CBIFS) assumes relevance and deserves serious considerations in the farming sector of the mid land and coastal Kerala for enhancing the return from unit area.

In this article an attempt is made to compare the economics of CBIFS models of different land holding sizes in terms of profitability and sustainability of the system compared to coconut alone, based on the analyse, more than 10 homestead based integrated farming system units developed during the last five years in Alappuzha district, Kerala. Three land holding sizes viz., up to 0.75, 0.76-1.5 and 1.51-2.5 acres were considered for the purpose, based on the prevalence. Different components and their extend in different holding sizes, in general, are as given below.

Up to 0.75 acre	0.76-1.5 acres	1.51-2.5 acres
Coconut (25) + Banana (150) + Vegetable (5 cents) Tuber crops (2 cents) + Fodder (20 cents) + Dairy (2) + Goat (2) + Poultry (30) + Duck (25) + Fish (2cents) + Biogas (1cu.m.)	Coconut (40) + Banana (300) + Spices (1 cent) + Vegetables (5cents) + Tuber crops (5 cents) + Fodder (70cents) + Vegetable (Rain shelter) (1cent) + Dairy (10) + goat (15) + Poultry (50) + Duck (45) + Quail (20) + Fish (6 cents) + Biogas (2 cu.m.)	Coconut (70) + Banana (400) + Spices (10 cents) + Vegetables (5 cents) + Tuber crops (10 cents) + Fodder (1 acre) + Rain shelter (1 cent) + Upland paddy (50 cents) + Dairy (15) + goat (20) + Poultry (75) + Duck (50) + Quail (50) + Fish (6 cents) + Biogas (2 cu.m.)

Income and profitability

Annual returns from components of the CBIFS models of different land holding sizes are given in table 1. It is observed that the net returns from the model is Rs.2.35, 7.88, and 12.87 lakhs, respectively for <0.75, 0.76-1.5, and 1.51-205 acre holdings. At

Table 1.Comparison of economics of monocropping and CBIFS models in different of land holding sizes

Holding size	Farming System	Annual expenditure (Rs.)	Annual income (Rs.)	Net Returns (Rs.)	Additional Net Returns (Rs)	Employment generation (man days)
up to 0.75 acres	Coconut alone (50 No.s)	28150	52500	24350	-	32
	Coconut (25) + Banana (150) + Vegetable (5 cents) Tuber crops (2 cents) + Fodder (20 cents) + Dairy (2) + Goat (2) + Poultry (30) + Duck (25) + Fish (2cents) + Biogas (1cu.m.)	219125	454250	235125	210775 (865%)	175
0.76-1.5 acres	Coconut alone (100 No.s)	56300	105000	48700	-	58
	Coconut (40) + Banana (300) + Spices (1 cent) + Vegetables (5cents) + Tuber crops (5 cents) + Fodder (70cents) + Vegetable (Rain shelter) (1cent) + Dairy (10) + goat (15) + Poultry (50) + Duck (45) + Quail (20) + Fish (6 cents) + Biogas (2 cu.m.)	777920	1565548	787628	738928 (1517%)	395
1.51-2.5 acres	Coconut alone (170 No.s)	95710	178500	82790	-	93
	Coconut (70) + Banana (400) + Spices (10 cents) + Vegetables (5 cents) + Tuber crops (10 cents) + Fodder (1 acre) + Rain shelter (1 cent) + Upland paddy (50 cents) + Dairy (15) + goat (20) + Poultry (75) + Duck (50) + Quail (50) + Fish (6 cents) + Biogas (2 cu.m.)	1201000	2404748	1286538	1203748 (1453%)	426

Figures in parentheses indicate the percentage increase compared to coconut monocropping system

Table 2. Frequency of income and annual net returns from different components of CBIFS models of different land holding sizes (Rs.)							
IFS Components	Frequency of income	up to 0.75 acre		0.76 – 1.5 acres		1.51-2.5 acres	
		Area/ No of plants	Annual net Returns	Area/ No. of plants	Annual net Returns	Area/ No. of plants	Annual net Returns
Coconut	Bimonthly	25	15000	40	24000	70	42000
Banana	Annual	150	21750	300	43500	400	58000
Vegetables	Weekly	5 cents	2900	5 cents	2900	5 cents	2900
Tubers	Annual	2 cents	11700	5 cents	29250	10 cents	60000
Spices	Annual	-	-	1 cent	6200	10 cents	62000
Veg (Rain shelter)	Weekly	-	-	1cent	800	1 cent	800
Upland paddy	Once in a year	-	-	-	-	50 cents	2000
Fodder	Savings	20 cents	26400	70 cents	92400	1 acre	132000
Dairy	Daily	2	87000	10	435000	15	652500
Goat	Annual	2	4300	15	32250	20	43000
Poultry	Daily	30	21900	50	37000	75	55500
Duck	Daily	25	25175	45	45540	50	50600
Quail	Daily	-	-	20	2440	50	6100
Fish	Annual	2 cents	17800	6 cents	32748	6 cents	32748
Biogas	Savings	1 cu.m.	1200	2cu.m.	3600	2 cu.m.	3600
Total		**235125**		**787628**		**1286538**	

the same time, from the same sized holding, the net return in the case of coconut alone is Rs.0.24, 0.49, and 0.83 lakhs, respectively (Table 2). As the land holding size increased, the income level also increased when the components are integrated. Moreover, daily income to meet the family expenditure is ensured only when animal components are integrated. Income at different intervals/frequency ranging from daily to annual in the case of CBIFS provides better livelihood and social security to farmers. While poultry and dairy provides daily income, vegetables provide income on weekly/fortnightly basis and other enterprises on quarterly or annual basis. This helps the farmer in meeting the daily and long term requirements in addition to the nutritional security achieved by way of quality food at a cheaper cost. Thus among all the land holding levels, integrated farming system presents a higher degree of resource use efficiency and productivity. Significant improvement in productivity of coconut palms could be observed over a period of three years. Effective recycling of organic residues and animal wastes for crop production ensured higher productivity of all crops including that of coconut in this system.

Additional Net Returns (ANR) and employment generation by integration of different components in coconut gardens (Table 2) clearly establish that by integrating crops and livestock components and residue recycling, CBIFS could be the ideal system for the coconut farmers to realize the highest returns and sustainability of farm income. While the increase in annual net returns is almost 8.5 times in holdings up to 0.75 acres, it is 15.1, and 14.5 times in holdings of 0.76-1.5 and 1.51-2.5 acres, respectively compared to the returns from coconut monocropping plots. In the case of employment generation also CBIFS was found superior by providing almost 4 to 7 times compared to coconut alone. Considering the very high ANR realized, and the fact that additional labour requirement could comfortably met by family labour, the CBIFS becomes a very lucrative, sustainable and




manageable system for coconut farmers. The most highlighting fact is the high involvement of women in the management of poultry, goat and livestock in the CBIFS which makes it further viable. Thus CBIFS is essentially to be adopted for the profitability and sustainability of the coconut production system.

Integration of different component activities in agricultural and allied sector could be the only option for enhancing the return from coconut gardens, especially in the coastal districts of Kerala where the average land holding size is very less. Monocropping of coconut provides only a low net return and employment potential in all the land holding sizes, and majority of the works are male oriented. When coconut gardens are integrated with crops, livestock, and fisheries, it provided frequent and intermittent returns and regular employment throughout the year for the whole family. Thus in all the land holding levels, coconut based integrated farming system recorded a higher degree of resource use efficiency, productivity and sustainability which is confirmed by the consistent income and employment generation from the system. ■

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Successful establishment of coconut garden- tips and techniques

M. Shareefa, Mayalekshmi, H. Mohammed, Anandha Narayanan and Regi J. Thomas
ICAR-CPCRI, Regional Station, Kayamkulam, Kerala

Coconut *(Cocos nucifera L.)*is one of the most versatile crops of the tropics on account of its multi-faceted uses to mankind. Coconut is generally seed propagated and it provides nutritious food and refreshing drink, edible oil and non-edible uses, fiber of commercial value, shells for fuel and industrial uses, timber and a variety of miscellaneous products for domestic and industrial uses.

Quality planting material is one of the important components for enhancing the production and productivity of any crop. It has more relevance in a crop like coconut with a gestation period of four to six years and a bearing period of more than 60 years. Area expansion scheme of coconut promoted by Coconut Development Board is taking place at a faster pace in many North Eastern States. It is also happening in states like Kerala, where State Government funded schemes like Coconut Development Council programme aims to increase the area under coconut cultivation. Selecting the right variety and the initial care holds the key for successful establishment of coconut gardens. Tips for selecting the ideal coconut variety and standard procedures to be followed after purchasing the seedlings from a reliable source and the initial care to be provided are listed in this article.

Identification of suitable varieties for the location

There are two types of coconut-Talls and Dwarfs. The tall cultivars that are extensively grown are the West Coast Tall and East Coast Tall. The dwarf variety is shorter in stature and its life span is short as compared to the tall.The tall palms are the most commonly cultivated for commercial production in all coconut growing regions of the world. Dwarf palms have gained importance in recent times due to tender nut water qualities and resistance to certain diseases.The selection variety depends on suitability of the variety to a particular location, purpose of cultivation and interest of the farmers. For example, if the location is water scarce area, select drought tolerant varieties, or if the location is root disease prevalent tract, select root (wilt) resistant/ tolerant varieties. If the farmer is interested in commercial

cultivation of coconut for copra and oil, tall varieties are preferred, and for tendernut purpose dwarf and hybrids are prefered. For large-scale cultivation, either tall alone or tall, dwarf and hybrids in 60:20:20 is preferable, and for homestead cultivation with limited space, dwarfs or hybrids are preferred.Some of coconut varieties recommended for cultivation are given in Table1.

Table1. Varieties of coconut based on utility

Sl. No.	Purpose	Varieties
1	Tendernut purpose	Kalpasree, Kalparaksha, Kalpa Surya, Kalpa Jyothi, Chowghat Orange Dwarf
2	Oil and copra	Chandra Kalpa, Kalpa Prathibha, Kalpa Mitra, KalpaDhenu
3	Neera	Chandra Kalpa
4	Ball copra	Kalpatharu
5	Dual purpose	Kera Chandra, Kalpa Prathibha, Kalpa Haritha
6	Coir fibre	Kalpatharu
7	Pest and diseases	Root (wilt) disease tract- Kalpasree, Kalparaksha, Kalpa Sankara
	Eriophyid Mite: Kalpa Haritha	
8	Drought	Chandra Kalpa, Kalpa Mitra, Kalpa Dhenu, Kalpatharu

Sources of quality planting materials

Good quality planting materials are first and foremost factor for successful coconut farming. Always purchase quality planting materials from reliable sources like,State government accredited/ NHB accredited nurseries, State Agricultural Universities, Farms of Coconut Development Board, ICAR-CPCRIetc. Farmers also can raise seedlings following the standard protocols.

Criteria for selection of quality seedlings of coconut

The best time when seedlings can be removed from nursery for transplanting is when they are one year old. 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, and large number of roots.
2. Early splitting of leaves into leaflets is a good sign of vigour
3. Number of leaves should be more than six
4. Collar girth of seedling should be more than 10 cm

Age of seedlings selected for planting

In general, one year old seedlings are preferred for planting in the field. However, seedlings upto the age of two years can also be used for planting especially in water logged areas. This is being practiced in Tamilnadu and Andhra Pradesh. In these cases, care should be taken for uprooting the seedling without damaging the root system. Two or three year old seedlings are generally preferred for planting in bunds of rice fields or similar situations and after planting they have to be held firm by suitable props for about a year till the seedlings strike roots and get established. The research on developing seedling standard for six month and nine month old seedling is in progress at ICAR-CPCRI.

Holding time of seedling after uprooting

It is always advisable to plant the seedlings as early as possible after uprooting from the nursery. However, under unavoidable circumstances (field is not ready due to heavy rain) coconut seedling can be kept for about two weeks under careful storage. In such cases, the seedlings should be kept under shade

and also watered. Care should be taken to protect the husk portion of the seedlings from termite attack during storage.

Table 2

Sl.No.	Recommended location	Varieties
1	Kerala	Kalpa Jyothi, Kalpa Surya, Chandra Kalpa, Kera Chandra, Kalpa Pratibha, KalpaDhenu, Kalpa Mitra, Kalpatharu, Kera Keralam, Kalpa Haritha, KalpaShatabti, KalpaRatna, Chandra Sankara, Kera Sankara, KalpaSamrudhi, KalpaSreshta
2	Tamilnadu	ALR (CN) 2, Kera Keralam, Kalpa Surya, Kalpa Pratibha, KalpaDhenu (East Coast), Kalpatharu, KalpaShatabti, KalpaRatna
3	Karnataka	Kalpatharu, Kalpa Jyothi, Kalpa Surya, Chandra Kalpa, Kalpa Haritha, KalpaShatabti, Chandra Sankara, KalpaSreshta
4	Andhra	Gauthami Ganga, Chandra Kalpa, Kera Chandra (coastal area), Kalpa Pratibha, KalpaDhenu, Kera Sankara(Coastal)
5	Maharastra	Pratap, Chandra Kalpa, Kera Chandra(Konkan), Kalpa Pratibha, Kera Sankara(Coastal)
6	West Bengal	Kalyani Coconut-1, Kera Chandra, Kalpa Mitra, Kera Keralam
7	Assam	Kamrupa, KalpaSamrudhi
8	Chhattisgarh	Kera Bastar
9	Andaman& Nicobar island	CARI-C1 (Annapurna), CARI- C2 (Surya), CARI- C3 (Omkar), CARI- C4 (Chandan), KalpaDhenu

Polybag seedlings- Advantages

Generally, coconut seedlings are sold during the month of May/June and polybags seedlings are ideal in situation where the field is not ready due to water stagnation. The polybag seedling can be planted when the situation becomes favourable for planting. Another advantage of polybag seedlings is that there is no transplanting shock and the seedlings will grow continuously with better vigour after planting.

Scientific planting of coconut seedlings

Well drained sandy loam soils are best suited for coconut cultivation. The land should be open without any trees so as to get maximum sunlight to the palms. If the land is uneven and full of shrubs, the shrubs have to be cleared and leveled before taking pits. Adequate supply of water either through well

Table 3

Year of planting	May - June			September- October		
	Urea	Musso-riephos	MOP	Urea	Musso-riephos	MOP
First year	Planting in May- June			110	150	170
Second year	120	170	190	240	340	375
Third year	240	340	380	480	680	750
Fourth year onwards	365	500	565	730	1000	1125

distributed rainfall or irrigation are to be ensured. In sloppy areas, soil and water conservation measures are to be adopted. In low-lying water-logged areas, planting is done on raised mounds. In laterite soils, addition of 2 kg common salt prior to 6 months of planting will help in loosening the soil. A spacing of 7.5 m x 7.5 m is generally recommended. The depth of pits will depend upon the type of soil. In laterite soils deeper and wide pits, size 1.2 x 1.2 x1.2 m, may be dug and in sandy loam soils, pits of size, 1 x1 x 1 m is sufficient. The pit is filled with top soil, powdered cow dung, and ash upto a height of 60 cm and a small pit is dug at the centre for planting the seedling.

At the time of planting, older roots can be removed as new roots emerge after planting. After planting, press the soil well around the seedling. Bio-priming of seedlings with bio-inoculants such as Pseudomonas fluorescens imparts tolerance to disease as well as promotes better seedling growth. Initial establishment of such seedlings was found to be superior in the main field with enhanced vigour and field tolerance to diseases. At the time of planting in the main field, dip coconut seedlings in 200 of P.fluorescens with 500g organic manure.

Precaution while taking up underplanting

Under planting can be taken up at 7.5 m X 7.5 m spacing. However, for better establishment of underplanted palms it is advisable to remove the old palms @ 25% annualy. This ensures that in a period of four years the entire old palms are removed and the underplanted palms gets sufficient sunlight for good establishment and early flowering.Shade of the old palms will have a detrimental effect on the flowering of underplanted palms. Any delay in removing the old palms will naturally delay flowering of the underplanted palms.

Manuring

Regular manuring right from the first year of planting is essential for good vegetative growth, early flowering and bearing and high yield of coconut palms. The first application of fertilizer should be done three months after planting. During initial year the quantity of chemical fertilizer to be applied is one tenth of recommended dose of fertilizer for adult palm. During the second year, one third of the dose recommended for adult palms may be applied in two split doses in May- June and September- October. This dosage may be doubled during the third year. From fourth year onwards, fertilizer may be applied at the rate recommended for adult palms. The fertilizer schedule for young palms is given in table3. Along with second split dose during September - October, 3-5 kg organic manures such as vermicompost or neemcake (first year 3kg, second year 5kg, third year onwards 10kg)may be spread in the pits and after applying the fertilizers, covered with soil.

Pest management in young coconut palms

Rhinoceros beetle infestation is commonly seen in young coconut palms and is more predominant in dwarf varieties than in talls. Adult beetle bores into the collar region of the coconut seedlings and brings forth dead heart-like symptoms. Central core of the spindle is severely affected and irrecoverable loss is induced. Extrusion of chewed up fibres at the bore hole is one of the characteristic symptoms of identification. In many cases, the growing point gets twisted, malformed and remarkable loss in vigour is observed. Presence of geometric V-shaped cuts on leaflets is quite common in juvenile palms. As prophylactic measure, the inner most leaf axils may be filled with neem cake or marotti cake @250g/ palm mixed with equal quantity of sand may be applied. Placement of two naphthalene balls (8g) in the leaf axils and covering with sand at 45 days interval is also effective. Alternatively placement of small perforated sachet containing 4-5 g Ferterra/ Fipronil in the inner most leaf axils may be attempted. Placement of old fish nets around collar region is also used for trapping the rhinoceros beetles.

It should be noted that dwarf varieties needs special care and attention till its flowering stage. Hence, dwarf varieties are recommended for planting in gardens very near to the place where the farmer stays. Talls are more robust and can be selected for establishing commercial gardens. As hybrids perform well under better management,it should be planted in situations where irrigation and recommended nutrients can be provided. Hybrids are not recommended for average management dependent solely on rainfed farming.

"Work your garden diligently. For the fruit will feed you today and the seeds hold the promise of being fed tomorrow"— Craig D. Lounsbrough ■

Coconut Planting and After Care

Neenu.S & Ravi Bhat
Central Plantation Crops Research Institute, Kasaragod

Coconut is a tropical crop and hence grows well in a hot climate.

Coconut thrives well within a latitude of 23 degrees of the equator (Between 20ºN and 20ºS latitudes) and an altitude upto 600 m above mean sea level. Temperature is one of the most important weather factors that has large influence on the growth and productivity of coconut. The coconut plants well adapted to a less diurnal variation between day and night temperatures and it does not withstand extreme temperatures. The range of temperature should be between 20° to 32°C, with a mean annual temperature of 27°C for better growth and yield. There may be reduction in yield when the mean temperature drop below 21°C. At the same time high temperature may also cause drying of developing inflorescences, and lead to decreased production especially in those months in the year.

The palm requires copiousness of sunlight and does not grow healthy under shade or in cloudy conditions hence should not be planted near heavy shade trees. Cloudiness seize the rate of transpiration. Coconut palms prefer bright sunshine and about 2000 hrs of sunshine in a year is required for the healthy growth of the palm. Coconut is grown in a wide variety of soils ranging from pure sand to clay and from moderately acidic to alkaline soil. Among that red sandy loam, coastal sandy, laterite and alluvial soils are more suitable. Heavy soils which lacks drainage facility are unsuitable for coconut cultivation. In areas with heavy rainfall, well drained soils and in low rainfall areas fine soils having good water holding capacity are more suitable for better growth of the plant. The ideal mean temperature is 27°C with 5-7° diurnal variation. A well distributed annual rainfall of 1300-2300 mm is ideal for the growth of coconut. To get good bearing coconut trees the farmer must be careful right from the planting stage. Coconut seedlings which are not correctly planted will bear late and may even die prematurely.

Land preparation

Land preparation for coconut planting should be based on the topography and the soil type. If the land

is too sloppy, suitable soil and water conservation methods should be adopted before planting. If water table is high mound planting can be followed. The land preparation includes the cutting and removing the logs and stumps, weeding and measures to control pests. The best time of planting of coconut seedling is along with the onset of pre monsoon showers. But if there is proper irrigation facility the planting can be done during summer months also.

The nature of preparation of land before planting depends upon slope of land, soil type and other environmental factors. The area should be cleaned and planting holes need to be marked out at appropriate places. If the land is slopy, soil conservation methods should be adopted. If the groundwater level is high planting may be taken up in the mounds. On slopes and in areas of undulating terrain, prepare the land by contour terracing or bunding. In low-lying areas and rice fields, form mounds to a height of at least 1m above water level. In reclaimed kayal/lake areas, planting can be done on the field bunds.

For raising nursery well-drained, coarse-textured soil with irrigation water facility should be selected. If there is no drainage problem the seed nuts can be sown in flat beds. In case of water stagnation problem is existing, raised beds are to be preferred. Nursery can be raised either in the open condition with artificial shade or in gardens where the tall palms are there to give enough shade. The seed nuts should be sown at a spacing of 40 cm x 30 cm during May-June in long and narrow beds, either horizontally or vertically in 20-25 cm deep trenches. Vertical planting has an added advantage of less damage during transit of seedling. On the other hand, in case of delayed planting, if the nut water goes down significantly, take up horizontal sowing. It is better to go for horizontal sowing of seed nuts for improved germination.

Transplanting of the seedlings can be done with the onset of monsoon season. The age of the seedling should be 8-10 months. Usually eight month old seedlings give a better insight for their growth and development. When the seedlings are too young, it is easy to see the difference in vigour between seedlings. In the case of polybag seedlings, first the polybags are to removed during transplanting. The top of the seed nut should be 5-8 cm below ground level. Deep planting will hinder the bud to come out and shallow planting may lead to the bending of planting material during heavy rains or windy days. There should be a slight depression towards the base of the crown to trap rain water.

Spacing and planting geometry

▶ *Planting Systems*

The spacing of planting may differ according to the type of cropping. Palms are planted at a spacing that allows the tips of horizontally held mature leaves to touch each other. The spacing between the plants is about 7-8 m for dwarf palms, 8-8.5 m for hybrids and 9-10 m for tall palms. This is because the crown size of tall palms are about 30% larger than hybrid and Dwarf varieties. This may result in the yield of about 115-236 palms/ha under triangle system, or 100-200 palms/ha under square system. In case of the same distance of planting, the triangular system can accommodate 15% more palms than the square system. As a guide, Table 1 shows the population and planting density under typical square and triangular systems of planting

Table -1

Sl No	System	Spacing
1	Triangular	7.6m
2	Square	7.6x7.6m, 8x8m, 9x9 m
3	Single Hedge	6.5m in rows - 9m between rows
4	Double Hedge	6.5 to 6.5m in rows - 9m between pairs of row

For getting superior yield from coconut, optimum plant density must be maintained in the field in such a way that there should be sufficient sunlight falling on coconut leaves during the growth phase and avoid excessive shading. A spacing of 7.6 m x 7.6 m to 8.0 m x 8.0 m in the square system is normally recommended for coconut. This will hold 177 and 156 palms per ha, respectively. If the triangular system is adopted, an extra 25 palms can be planted. Hedge system can also be adopted giving a spacing of 6.5 m along the rows and 9.5 m between rows. For facilitating multiple or intercropping in coconut gardens, it is advisable to go for wider spacing of 10 m x 10 m so as to make available liberal opportunity to house a number of perennial and annual crops in the inter spaces.

Table -2		
SPACING	POPULATION DENSITY (palms/ha)	
	SQUARE METHOD	TRIANGULAR METHOD
7.6 m x 7.6 m	177	198
8m x 8m	156	180
8.5 m x 8.5 m	138	160
9m x 9m	134	143

10 m x 10 m	100	115

For cultivating coconut on slopes and in areas of undulating topography, get ready the land by contour terracing or bunding. In low-lying areas or valley bottoms, mounds are to be prepared at planting site to a height of at least 1 m above water level. In reclaimed lands, seedlings are to be planted on field bunds. In case of loamy soils with low water table, the pit size should be 1mx1mx1m. In case of laterite soils with underlying bedrocks, make larger pits of size 1.2 m x 1.2 m x 1.2 m. In areas with sandy soils texture, the size of pit should not beyond 0.75 m x 0.75 m x 0.75 m. In case of well drained soils, seedlings can be transplanted with the commencement of rain. In case of low lying areas subject to flood during monsoon periods, it is advisable to plant the seedlings after the end of the monsoon.

Pit making and planting

Land preparation for planting coconut depends to a great extent on soil type and environmental factors. If the land is not leveled and full of shrubs, the shrubs have to be cleared and land should be leveled before digging pits. The depth of pits will depend upon the type of soil. In case of laterite soil with rocky substratum, deeper and wider pits, 1.5 m length x 1.5 m breadth x 1.2 m depth may be dug and filled up with loose soil, powdered cow dung and ash up to a depth of 60 cm before planting. In such soils it is recommended to add 2 kg of common salt to loosen the soil. In case of loamy soils with low water table, pit size of 1 m x 1 m x 1 m filled with top soil to height of 50 cm is generally recommended. At the centre of the pit make small hole and plant the

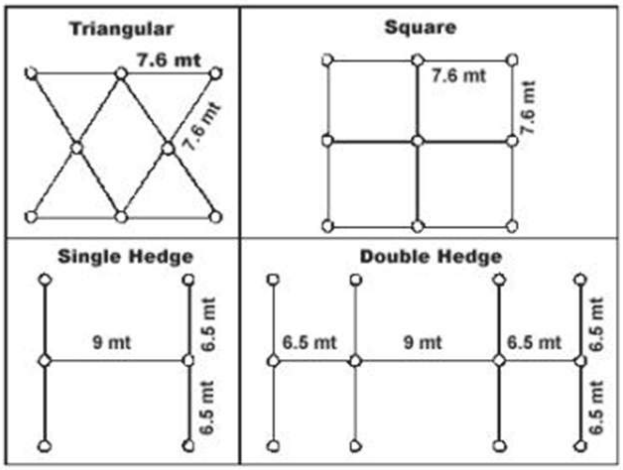

Fig. 1. The different systems of planting of coconut

coconut seedlings and the soil around the seedlings must be tightly pressed, but soil should not be allowed to bury the collar region of the seedling or enter into the leaf axils. If the water table is high, planting at the surface or even on mounds may be required. Although planting on the surface or mounds, digging pits and soil filling also have to be done. In case of filling the pits with soil, it is suitable to use top soil. At least two layers of coconut husk (with concave surface facing up) can be arranged at the bottom of the pit before filling up the pit. This will ensure the moisture conservation. In areas with littoral sandy soils application of 0.15m^3 red earth is recommended to improve the physical condition of the soil. In area with water logging, ensure proper drainage by making drainage channels.

Planting of seedling along with the onset of monsoon is recommend for the rapid establishment

Table 3: General fertilizer recommendation for coconut (g/palm)						
Age of coconut palm	May-June /September- October			May-June /September- October		
	N	P2O5	K2O	N	P2O5	K2O
First year	Planting in May - June			110	200	225
Second Year	110	200	225	240	400	450
Third Year	240	400	450	480	800	900
Fourth year onwards	370	600	670	715	1000	1330

of the plant in the main field. Rapid growth of the palms occurs during the first five years of planting in main field. The stem portion will be visible after growing 3-4 years and there will be 30-50 cm annual elongation of stem occurs during this period. In older palms the stem elongation process is slower compared to seedlings. At the extent of vegetative growth, the young trees produces nuts and it took 2-3 years to become stable in nut production.

Management of juvenile palms

Good care should be taken all through the early years of growth of young palms for getting high yield. After field planting staking has to be done to protect the seedlings from heavy wind and provide proper shading using plaited coconut leaves or any other suitable shading materials to protect from bright sunlight. Juvenile palms need sufficient moisture, at the same time they can not withstand water logging condition also. Hence care should be taken to avoid planting in lands prone to water logging. Field planted seedlings should be given adequate irrigation during the summer months. Irrigation using 45 litres of water once in 4 days has been found suitable in all soil types. If following drip irrigation, daily 10 litres of water should be provided. Proper drainage should be provided in areas prone to water stagnation. Weeding of the pits should done periodically. Washed down soil covering the collar region of the seedlings during the heavy rains should also be removed. Widening of the pits should be done each year prior to the application of manure. As the seedlings grow the pits should be gradually filled up with soil. A basin radius of 1.8 m from the trunk of the palm could be fully prepared by the fourth year. Insect and disease attach to the palms should be regularly monitored and required corrective measures should be taken up on time.

Under planting

Under planting (the term used for removing old trees and planting new seedlings) is done in plantations where the palms have become unproductive and uneconomic to the farmer. Very old palms are removed in stage wise over a period of 3 to 4 years. First the area underplanted is to be peg marked. At the outset, very poor yielders (less than 20 nuts per palm per year) and those trees which are very near to the peg marked point for underplanting are to be removed. Other palms are to be removed at the rate of one third each year during 2nd, 3rd and 4th year after underplanting. In the case of existing gardens if the plants are irregularly spaced, older palms within 1 m radial distance from the newly planted seedlings are to be removed in the first year of underplanting, two metre distance in the second year, three metre distance in the third year and the remaining ones in the fourth year.

Manuring

▶ *Nutrient requirement*

From the first year of planting onwards regular manuring is essential for good vegetative growth, early flowering and timely bearing and high yield of coconut palms. It is always recommended to test soil in the coconut garden (once in 3 years) and based on these results the type and rate of chemical fertilizers can be decided. In the main field, three months after planting, it is recommended to apply chemical fertilizers at the rate of one tenth of the recommended quantity of fertilizer for adult palms. This will be one third of the amount recommended for adult palms in the second year and apply in two split doses along with the start of rain.Twice the quantity of second year dose may be applied in third year as shown in Table 3. From fourth year fertilizers may be applied at the recommended rate for adult palms. In India, the general recommended dose of fertilizer per palm per year is at the rate of 500 g N, 320 g P2O5 and 1200 g K2O for adult plantations. To provide the above amount of nutrients for an adult palm, it is required to use about 1.1 kg urea, 1.5 kg rock phosphate (in acidic soil) or 2 kg super phosphate (in other soils) and 2 kg of muriate of potash (MOP). It can also be supplied through 700 g Di ammonium phosphate (DAP), 815 g of Urea and 2 kg of MOP.

Time and method of fertilizer application

The chemical fertilizers are applied in such a way that after the summer showers received, during May-June, 1/3rd of the suggested quantity of fertilizers may be distributed around the palm basins radius of 1.8 m and forked in. During August-September, prepare circular basins of 1.8 m radius at a depth of 20 cm and green leaf or compost or farm yard manure may be spread at the rate of 50 kg per palm basin. The leftover 2/3rd of the recommended amount of fertilizers may be spread on the green leaf or compost and covered. In places where irrigation facilities are available, it is appropriate to go for more number of split doses, as far as possible four split doses are suggested (March, June, September and December).

Besides the above fertilizers dose,one kg of finally ground dolomite or lime stone and 0.5 kg Magnesium sulphate should be applied per palm per year is recommended for acidic soils as well as light sandy soils. The dolomite/lime may be applied prior to the commencement of monsoon rain in the coconut basins and forked in. Care should be taken that liming materials should not be applied along with other chemical fertilizers. But magnesium sulphate can be applied along with other fertilizers. In case of laterite soils, 50 per cent of the K2O requirement of coconut can be substituted by Na2O supplied in the form of sodium chloride. Judicious application of micronutrients on the basis of soil test values, it is recommended to apply borax 120 g per palm in four equal split especially based on the intensity of deficiency symptoms.

▶ *Drip fertigation*

Wherever drip irrigation is available, it is possible to use soluble fertilizers like urea, Di ammonium phosphate, phosphoric acid (commercial grade) and muriate of potash along with drip irrigation in six equal split doses. Through fertigation, it is suggested to give 91 g urea, 33 ml phosphoric acid and 170 g muriate of potash per palm per application. If Di ammonimum phosphate is giving, it is advisable to give 70 g urea, 60 g DAP and 170 g muriate of potash for each dose per palm.

▶ *Organic manures*

Sufficient quantity of organic manure should be supplied to improve the soil quality and recycling of nutrients to coconut palms. Besides, organic manures aids in improving soil microbial activity and recycling of nutrients. Organic manures including compost, farm yard manure, green leaf manure or vermi compost can be applied to coconut palms. It is recommended to apply 10 kg/palm organic manure as compost or vermi compost or farmyard manure six months after planting in the main field. In the second year it can be increased to 20 kg per palm; in the third year the dose may be increased to 30 kg per palm and in the fourth year organic manure applied should be increased to 40 kg per palm. From fifth year onwards the dose may be fixed as 50 kg organic manure per palm per year. Coir pith compost (coir pith, poultry manure and lime and rock phosphate along with fresh glyricidia leaves /tender stem)can also be used as an enriched organic manure. Organic manures are applied during August-September in circular basins of 1.8 m radius and 20 cm depth. The recommended amount of organic manures may be spread in the entire basin.

Crop waste recycling

Organic manuring enhances physical, chemical and biological properties of the soil and hence a good organic base is important for the proper absorption of nutrients. Biomass like coconut leaves, spathe, bunch waste, husk of nuts etc are available from the coconut garden. Biomass from other annuals and perennials grown as inter or mixed crops in the garden can be recycled along with the coconut wastes. In the case of integrated system, the animal component may provide nutrient rich biomass from the system itself. The decomposition of these natural organic material will results slow nutrient release throughout year.

Irrigation management

As far as coconut cultivation is considered, moisture is the most limiting factor for nut production. In areas where long period of dry spells or ill distributed or scanty rainfall is prevailing irrigation is very much necessary to maintain the yield. Hence,

during summer months irrigate the palms in the basin area at a radius of 1.8 m and depth of 10-20 cm. According to climate and soil type, the water requirement of the palms may vary. In coconut, immediately after the juvenile phase the growth and reproductive stages simultaneously occurs and hence the palms require readily available moisture throughout their life cycle. The water requirement of coconut seedlings was about 1.591 and 1.533 mm per year when irrigation was given at 80-100% and 60-100% respectively. In the case of young palms upto first three years the water requirement was very low as the leaves are small. An adult palm requires around 600-800 litres of water once in 4-7 days. Care should be taken that the seedlings and young palms should not be irrigated with sea water. Hence, once the irrigation is started it is recommended to follow systematic and regular irrigation.

Methods of irrigation

The most common irrigation methods in coconut gardens are flooding, basin irrigation, sprinkler or perfo-sprays and drip irrigation. There is a remarkable wastage of irrigation water in case of flood irrigation. Besides, it results in poor aeration especially in clayey soils and leads to water stagnation and it may lead to the spread of soil born pathogen causing Ganoderma like diseases. Therefore, flood irrigation is not a suitable irrigation method for coconut and if possible it should be avoided. In the case of basin irrigation, water is provided in the basins of coconut through irrigation channels. Main irrigation channels are made between the two rows and sub channels are prepared to connects each basin. This type of irrigation also causes minor losses of water by way of deep percolation, seepage and evaporation. But this loss will be minimum if the basins are irrigated with hose pipes. Using hose pipes helps to bring down water loss during transport.

Conclusion

Proper planting of seedlings, nutrient and irrigation management practices etc are the key factors to raise the coconut plants successfully. From the point of selection of nuts for seedling production to the establishment of adult palm are very important and care should be taken in each step to have good yielding palms. Management practices are very important and should be followed as per the instructions to maintain the growth and yield of the palm. ■

CDB participated in Vyapar 2022 B2B Meet

Coconut Development participated in Vyapar 2022 held at Jawaharlal Nehru Stadium from 16th to 18th June 2022.

Shri. P Rajeev, Minister for Law, Industries and Coir, Government of Kerala inaugurated the programme. The 3-day conclave had the convergence of representatives of all-India trade and commercial organisations, business consortiums, e-commerce executives, exporters, consumers, and buyers from top commercial establishments.

A total of 330 buyers and 324 sellers from across the country took part in the event organised by the Kerala Department of Industries and Commerce. The meet focused on food-processing and Ayurveda, followed by handlooms and textiles.

The expo at the event exhibited the MSME products, branded and otherwise. An interesting feature of the event was the presence of women entrepreneurs who set up 65 out of the 331 exhibition stalls to showcase a range of products to attract domestic buyers and global e-commerce giants such as Amazon and Flipkart. More than 50 manufacturers of coconut value added products including handicrafts had participated in the B2B meet.

Shri. P Rajeev, Minister for Law, Industries and Coir, Government of Kerala inaugurating Vyapar 2022

A view of the Board's stall

ICAR holds brainstorming session on mainstreaming agriculture curriculum in school education

Indian Council of Agricultural Research (ICAR) organized a brainstorming session on14th June 2022 to mainstream agriculture curriculum in school education. Union Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar inaugurated the programme. Speaking on the occasion, Shri Tomar said that agriculture sector occupies a very important place in the country and the livelihood of large population is dependent on agriculture. Agriculture is India's strength and its predominance will not only remain in the future but it will also expand. In view of this, ICAR has made an effort to integrate the agriculture world with the new education policy.

The objective of this event was to focus on designing agricultural education system towards developing vocational curriculum including agricultural science to provide better education

Shri Narendra Singh Tomar, Union Minister of Agriculture and Farmers Welfare inaugurating the session

under the National Education Policy (NEP), 2020. Therefore, a new paradigm will be introduced at the primary, middle and secondary school levels, with vocational courses at the higher level for the development of students and youth in agriculture and allied sciences. As a result, this brainstorming session will help develop and evolve a policy to include agriculture as a subject in the curriculum and provide students with an option to pursue a career in various fields of agriculture.

Shri Tomar said that the agriculture sector has supported the country like a backbone even in adverse circumstances. Recently, our agriculture sector has performed well despite the Covid crisis. There is a need for continuous improvement, increased investment and technology support in this area. Prime Minister Shri Narendra Modi also wants that farmers should move towards prosperity by adopting these measures and accordingly the government has taken many concrete steps. There are many dimensions in agriculture, on which it is necessary to work together, while the challenges have also been overcome at a fast pace. Towards this end, agricultural curriculum should also find a place in school education and it is necessary that there should be continuity in agriculture and every Indian should be connected with it. Shri Tomar said that if the interest towards agriculture sustains in the children from the school level, then they will be able to move towards agriculture after college. Our farmers are naturally skilled workers. In the present circumstances, the agriculture sector is going to create a lot of employment opportunities in the times to come. In this regard, he mentioned about linking agriculture with technology and setting up of the Agriculture Infrastructure Fund worth Rupees one lakh crore by the central government.

Dr. Trilochan Mohapatra, Secretary, DARE and Director General of ICAR was present in the brainstorming session. ICAR Deputy Director General (Agriculture Education) Dr. R.C. Agrawal gave a presentation on the current status of agricultural education in the country and the need to bring agricultural education at the school level. Principals of schools, senior teachers and other experts including officials of ICAR, NCERT and CBSE participated in various sessions and deliberated upon the need and process to include agriculture as a subject in the school curriculum. The delegates discussed the necessary policy level interventions at the State-Centre level, constitution of a Joint Working Group of teachers to review the existing curriculum and propose changes needed to enhance subject knowledge and teaching skills in agriculture at the school level. Based on the consultations of school education experts, panelists, professionals and experts from ICAR, it is expected that this unique initiative of its kind will create a sense of much needed change in the school curriculum to prepare the students and youth for better agricultural development. For our primarily agricultural economy, this is a necessary step towards building an AatmaNirbhar Bharat, a self-reliant India.

Kalpa Vajra

As part of Azadi Ka Amrit Mahotsav as well as Annadata Devo Bhava, ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam organized inaugural function of the year long Kalpa Vajra celebrations (2022-2023) on 24th April 2022. Shri P. Prasad, Hon'ble Minster for Agriculture Development and Farmer's Welfare, Govt of Kerala inaugurated the programme. Adv. A.M. Arif, Hon'ble Member of Parliament, Alappuzha presided over. Dr P. Anithakumari, Acting Head, ICAR-CPCRI, Regional Station, Kayamkulam welcomed the gathering and highlighted on the significant accomplishments of the station.

In his inaugural address, Shri P. Prasad, Hon'ble Minster for Agriculture Development and Farmer's Welfare, Govt of Kerala emphasised on the value

Adv. A.M. Arif, Hon'ble Member of Parliament, Alappuzha, lighting the lamp during the programme

addition in coconut for doubling income and make farmers prosperous. He further outlined on the higher quality of coconut from Kerala and advised to tap its superiority empowering FPOs. He outlined the research accomplishments of the Station and its service to the coconut community.

Adv A.M Arif, Hon'ble Member of Parliament, Alappuzha, in his presidential address spoke on the need to enhance the production potential of coconut in general and Kerala in particular to cater to the need of ever-growing demand. He urged that research organizations like ICAR-CPCRI should work at tandem with State Department of Agriculture and KVKs to outreach the latest technologies in a farmer-participatory mode so as to revitalise the agrarian economy. He handed over the Snow Ball Tender Nut (SBTN) technology developed by ICAR-CPCRI to entrepreneur and released their logo. The year long Kalpa Vajra (2022-2023) programme schedule was also launched by him during the occasion.

Smt. P Sasikala, Chairperson, Kayamkulam Municipality released the coffee table book on "ICAR-CPCRI, Regional Station, Kayamkulam @75-Serving Coconut Farmers since 1947"and inaugurated the exhibitions conducted by different Government agencies as well as the Farmer's group under the Farmer-FIRST programme marking smart technological display for effective dissemination.

Sri. Shani Kurumbolil, President, Krishnapuram Grama Panchayat honoured Sri P.M. Mathew, Kera Kesari Award Winner (2009-10) from Agali,Attapadi (Palakkad District)and offered felicitations.Dr Regi Jacob Thomas, Principal Scientist and Chairman, Programme Committee proposed vote of thanks. The foundation stone of the Kayamkulam station

Smt. P Sasikala, Chairperson, Kayamkulam Municipality releasing the coffee table book

was laid by His Highness Marthanda Varma B.A., Elyaraja of princely state of Travancore way back on 24-04-1947, just prior to India's Independence.

A farmers' seminar was also held chaired by Dr. George V. Thomas, Former Director, ICAR-CPCRI. In the technical session Mr. P.M. Mathew, 'Kera Kesari' Award winner shared his experience on inclusive farming. Mrs. Leenamol M.A., Market Promotion Officer, CDB, spoke on the various schemes implemented by Coconut Development Board, Kochi. Mrs. Renu P. Viswam, Statistical Investigator, CDB briefed on 'Crop insurance &Kera Suraksha Scheme'. Dr. S. Radhakrishnan, Sr. Scientific Officer, Central Coir Research Institute, Kalavoor talked on 'Coir and value-added coir products for sustainable development'. Dr A. Abdul Haris, Principal Scientist, ICAR-CPCRI, RS, Kayamkulam spoke on 'Organic coconut cultivation'. Dr P. Subramanian, Principal Scientist, ICAR-CPCRI, Kasaragod empowered the farmers on 'High density multi species cropping involving spices and cocoa'. More than 700 farmers attended the programme.

Biofactories with mass production of coconut plantlets – The Way Ahead

Dr. Anand Kumar Singh, Deputy Director General, ICAR, India inaugurating the workshop

Coconut products are making their presence felt in the global market with export volumes increasing every year. With an increasing trend in export predicted by every single market study across the globe, it is equally important to assure the availability of quality coconuts for processing. World over and also in India, the coconut sector is faced with an increasing proportion of unproductive and senile palms which need to be replanted. The International Coconut Community(ICC) estimates a demand of over nine million seedlings for replanting across the globe. It is in this context that the International Tissue Culture Workshop with the theme "Collaborative Initiatives towards Enhancing Tissue Culture R & D"organized during 16-20 May 2022 in India holds increased relevance.

The workshop was organized by ICC under the International Coconut Genetic Resources Network (COGENT) and hosted by the ICAR-Central Plantation Crop Research Institute (CPCRI). The International Thematic Action Group (ITAG 4) of COGENT led the workshop and served as the technical team working on In-vitro Culture and Cryopreservation.

The workshop was primarily meant to create a platform for sharing of expertise and developing the skills of researchers working on coconut tissue culture in support of the conservation, germplasm exchange and mass propagation program among member countries of COGENT.Tissue culture experts from across the globe had participated in the workshop, presented updates on the research and development in their country and provided hand-to-hand skill demonstration to the participants from eight coconut growing countries. The countries hosting the International Coconut Genebanks(ICGs) from Cote d' Ivoire, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Sri Lanka and Vietnam also participated. Representatives from each country presented the progresses and challenges of coconut tissue culture they faced.

The Inaugural programme

The workshop started on 16th May with a formal inauguration of the event by Dr. Anand Kumar Singh, Deputy Director General, ICAR, India. He appreciated the activities of ICC and the developments in coconut tissue culture and called for the active involvement of all participants and requested to extract maximum information and develop skills to undertake tissue culture work in their respective countries. Dr. Jelfina C. Alouw, Executive Director of ICC, presented the overview of COGENT program, followed by address of Mrs. Erlene C. Manohar, COGENT Coordinator on the Coconut Conservation Strategy. Dr. Anitha Karun, Director, ICAR-CPCRI delivered the keynote address. The inaugural session concluded with the vote of thanks by Dr. Niral Vittal.

The Participants

The Workshop
The four-day workshop was divided into five major sessions followed by hand-to-hand demonstrations to the participants.
● Demonstration of Embryo Culture and Exchange Protocols
● Demonstration of Ex Vitro Plantlet Establishment
● Demonstration of Clonal Propagation Protocols
● Demonstration of Coconut Cryopreservation Protocols
● Networking and International Project Development

Dr. Anitha Karun, Director, CPCRI made a presentation on Pollen cryopreservation protocol in coconut developed by CPCRI in detail elaborating of the different stages from ideal conditions for collection, viability assessment, cryopreservation, assessment of fertility etc. Dr. Cristeta A. Cueto of the Philippine Coconut Authority had presented on Coconut Embryo Culture and Transfer and detailed on the lab requirements, media preparation, types of culture, extraction of embryos, surface sterilization, culture of embryos and coconut embryo transfer. Dr. Bart Panis, Bioversity International Belgium presented on the topic, cryopreservation protocols for shoot tip culture. The cryopreservation techniques applied on coconut include complete mature zygotic embryos, plumules, shoot tips from shoot tip cultures, pollen and embryogenic callus. Dr. Carlos Oropeza, CICY Mexico had presented on Somatic embryogenesis in

Dr. Jelfina C. Alouw,
Executive Director, ICC

coconut in which zomatic embryos were isolated to form embryogenic callus leading to shoot formation. He explained that one plumule had a potential to produce 100,000 somatic embryos. Dr. Quang Nguyen, Vietnam International University further presented on the 'International Exchange of Coconut Germplasm using Embryo Culture Technique' detailing the medium preparation, embryo isolation and exchange procedures. Dr. SundarKalaipandian from University of Queensland shared the details of cryopreservation protocols for coconut zygotic embryoes. Dr. Vijitha Vidhanaarachchi from Coconut Research Institute, Sri Lanka had presented on the Coconut somatic embryogenesis with unfertilized ovary culture. Dr. Regi Thomas, Dr. M. K Rajesh and Dr. Shareefa from CPCRI presented and shared the details on technology development with practical demonstrations.

The open discussion after each session followed by the hand-to-hand practical demonstrations on

A view of the practical session

different aspects enabled better learning experience for the participants. The participants were taken to the different sections of the CPCRI for internal campus visit including the laboratory visits to make them understand the activities of CPCRI.

The participants were divided into five groups for the group activities under the guidance of resource speakers in which each group presented views on their research proposals and the way forward. Mrs. Erlene C. Manohar COGENT Coordinator presented the synthesis of the workshop and action plan.

Certificate of appreciation and participation were distributed to all the resource speakers and participants. The four-day workshop concluded with the closing remarks of Dr. Jelfina C. Alouw, Executive Director. In her remarks she thanked the organizers and sponsors ACIAR, CPCRI and Coconut Development Board of India. She appreciated the resource speakers and the participants for their active participation in the workshop and called for adoption and replication of the technologies presented. The symposium was moderated by Mr. Vincent Johnson, COGENT Coordination Support.

A field visit was also organized to the plantation of Mr. A. Narayanan Nair, one of the progressive farmers wherein the multistoried coconut cultivation model was displayed. The team also visited Vittal Agro Products, one of the biggest Desiccated Coconut Powder manufacturers of India, with a capacity of processing 1.5 lakh coconuts per day.

The workshop helped in showcasing of the various technologies developed in tissue culture and led to deliberations by researchers, scientists and trainees on the potential method to adopt for better results leading to mass production of quality coconut seedlings. The scientists maintained high spirits and prospects for a near future where success is realized in mass propagation of coconut. ■

Report prepared by: Smt. Deepthi Nair S, Deputy Director, CDB

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Cultivation Practices for Coconut-July

Planting

In localities where the onset of south-west monsoon was delayed or received inadequate rainfall, planting of seedlings may be taken up in July. If continuous heavy rain occurs after planting, care should be taken to avoid water stagnation in the pit by providing drainage.

Bund should be made around the planting pit using bottom soil to avoid run-off water entering the pit.

Nursery management

Weeding should be done wherever necessary. Water stagnation should be avoided in the nursery bed by providing adequate drainage.

Plant protection

The active monsoon phase of July month is the period of pest recession and disease escalation. Wetness usually reduces the pest incidence but aggravates the spread of disease propagules. It is therefore a period of critical monitoring to prevent the entry of deadly pathogen such as bud rot disease into the palm system. Any injury due to pest incidence would also favour higher occurrence of disease on palms. Incidences of rugose spiralling whitefly, nesting whitefly and black headed caterpillar would be in the diminishing phase and the attack by red palm weevil would be emerging fast in different localities. Bud rot and leaf rot diseases are common diseases during the period.

Red palm weevil *(Rhynchophorus ferrugineus)*

Reduction in the incidences of rhinoceros beetle, would subsequently suppress the invasive potential of the killer pest, viz., the red palm weevil, which needs an injury for the weevils to orient towards the palm cue and lay eggs. Dwarf genotypes and palms aged between 5-15 years are relatively more susceptible. All life stages of the pest were noticed inside the infested palms. Being a fatal enemy of palms, 1% action threshold has been fixed. Correct geometry is very crucial for accommodating intercrops as well as pest avoidance due to multiple odour cues.

Adult weevils

▶ *Management*

- Field sanitation is very critical and all residual population in crown toppled palms should be destroyed
- Avoiding palm injury is very critical to disorient the gravid weevils away from the field and therefore leave out at least one metre from palm trunk when petioles are cut.
- Crop geometry and correct spacing is very crucial to reduce pest attack.

- Timely and targeted spot application of imidacloprid 0.002% (1 ml per litre of water) or indoxocarb 0.04% (2.5 ml per litre of water) on infested palms would kill the feeding grubs and induces recovery of palms by putting forth new spear leaf.

Crown entry

- Crop-habitat diversification (Ecological Bio-engineering) through coconut based cropping system strategy inciting defenders and pollinators would diffuse the palm-linked volatile cues and encouraged pest suppression. Diversified cropping system reduces pest incidence than mono-cropping.

Toppling of palm

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, however, a recent outbreak during May-June in certain tracts of Kasaragod district is reported. 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

Pest-infested field

Black headed caterpillar Goniozus nephantidis

in tremendous reduction in photosynthetic area, decline in rate of production of spikes, increased premature nut fall and retarded growth. Extensive feeding of caterpillars causes a crop loss of 45.4% in terms of nut yield in addition to rendering the fronds unsuitable for thatching and other purposes. Farmers need not panic and this approach is one of the classical examples of successful augmentative biological control suppressed by natural enemies.

▶ *Management*

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-

P.bondari

P. minei

Cybocephalus sp.

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.

Nesting whiteflies (*Paraleyrodes bondari and Paraleyrodes minei)*

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

▶ *Management*

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms
- Effective nitidulid predators belonging to Cybocephalus sp. were observed on the palm system and pesticide holiday is advised for conservation biological control.

Diseases

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

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

▶ *Management*

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

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

In certain humid locations bud rot occurred regularly killing hundreds of trees. In India, bud rot incidence is recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or spindle turns brown and bends down. The

Leaf rot disease affected palm leaflets

affected spear leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Temperature range of 20- 24ºC and relative humidity of 98% - 100% were found optimum for the development of the bud rot disease. Contiguous occurrence of such "favourable days" during rainy seasons determines the development of the disease and the intensity of infection. As Phytophthora diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.

▶ *Management*

- Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence.
- Field sanitation and provide proper drainage during rainy season.
- Placement of two Trichoderma (Trichoderma harzianum CPTD28 isolate) enriched coir pith cakes in the inner most leaf axils just before the onset of monsoon and again after every two monthsas prophylactic measure.
- In disease affected palms, remove the entire rotten portion of the spindle by cutting with a sharp knife and apply 10% Bordeaux paste to the wound and cover with polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.

Correct and timely diagnosis of insect pests as well as disease causing pathogens would be the key factors for the implementation of effective management solutions. Delayed detection would take a longer time for recovery from pest invasion. Prophylactic treatment evading diseases are very important during monsoon phase. Hence a close scrutiny of palms through effective scouting and timely diagnosis would form the basis in doubling income through increased production. ■

Withering of spear leaf

Market Review – May 2022

Domestic Price

Coconut Oil

During the month of May 2022, the price of coconut oil opened at Rs. 15400 per quintal at Kochi, Alappuzha and Kozhikode market. The price closed with a net loss of Rs. 800 per quintal at Kochi and Alappuzha market and a net loss of Rs. 600 per quintal at Kozhikode market.

The price of coconut oil closed at Rs. 14600 per quintal at Kochi , Alappuzha and Rs. 14800 per quintal at Kozhikode market.

During the month, the price of coconut oil at Kangayam market opened at Rs. 13267 per quintal and closed at Rs. 12467 per quintal with a net loss of Rs. 800 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
04.05.2022	15400	15400	15400	13267
07.05.2022	15400	15400	15400	13133
14.05.2022	15100	15200	15100	12733
21.05.2022	15000	15000	14900	12333
28.05.2022	14600	14600	14800	12267
31.05.2022	14600	14600	14800	12467

Milling copra

During the month, the price of milling copra opened at Rs.9200 per quintal at Kochi and Rs.9150 per quintal at Alappuzha and Rs.9250 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 8450 per quintal at Kochi market, Rs. 8400 per quintal at Alappuzha market and Rs. 8650 per quintal at Kozhikode market with a net loss of Rs.750 at Kochi and Alappuzha market and Rs. 600 per quintal at Kozhikode markets.

During the month the price of milling copra at Kangayam market opened at Rs.8700 and closed at Rs. 8200 per quintal with a net loss of Rs.500 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
04.05.2022	9200	9150	9250	8700
07.05.2022	9200	9150	9250	8700
14.05.2022	8900	8950	9000	8400
21.05.2022	8800	8750	8750	8100
28.05.2022	8450	8400	8650	8150
31.05.2022	8450	8400	8650	8200

Edible copra

During the month, the price of Rajpur copra at Kozhikode market opened at Rs. 15600 per quintal and closed at Rs. 13000 per quintal with a net loss of Rs. 2600 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
04.05.2022	15600
07.05.2022	14700
14.05.2022	14000
21.05.2022	13800
28.05.2022	13800
31.05.2022	13000

Ball copra

The price of ball copra at Tiptur market opened at Rs. 17000 per quintal and closed at Rs.13000 per quintal with a net loss of Rs.4000 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
04.05.2022	17000
07.05.2022	15700
14.05.2022	14500
21.05.2022	14800
28.05.2022	14000
31.05.2022	13000

*NR-Not reported

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.13000 and closed at Rs. 11500 per quintal with a net loss of Rs.1500 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
04.05.2022	11500
07.05.2022	11500
14.05.2022	11500
21.05.2022	11500
28.05.2022	11500
31.05.2022	11300

Coconut

At Nedumangad market in Kerala, the price of coconut opened and closed at Rs. 17000 per thousand nuts during the month.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 24000 per tonne and closed at Rs.21000 per tonne during the month with a net loss of Rs. 3000 per tonne.

At Bangalore market in Karnataka, the price of coconut opened and closed at Rs. 20000 per thousand nuts.

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

Weekly price of coconut at major markets				
	Nedumangad (Rs./1000 coconuts)#	Pollachi (Rs./MT) ##	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 tonne) ##
04.05.2022	17000	24000	20000	32000
07.05.2022	17000	24000	20000	30000
14.05.2022	17000	23000	20000	28000
21.05.2022	17000	21000	20000	28000
28.05.2022	17000	20500	20000	28000
31.05.2022	17000	21000	20000	26000

International price

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
07.05.2022	232	258	164	309
14.05.2022	232	248	NR	296
21.05.2022	197	254	NR	270
28.05.2022	NR	256	NR	264
				*Pollachi market

Coconut Oil

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

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
07.05.2022	1843	NR	NR	2215	1691
14.05.2022	1791	NR	NR	NR	1639
21.05.2022	1641	NR	NR	NR	1588
28.05.2022	NR	NR	NR	NR	1580
					*Kangayam

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
07.05.2022	1117	913	1022	1120
14.05.2022	1045	760	NR	1081
21.05.2022	970	696	NR	1043
28.05.2022	NR	757	NR	1049
				* Kangayam

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

Coconut Development Board

Chairman : 0484-2375216

Shri. Rajeev Bhushan Prasad
Chief Coconut Development Officer (i/c) : 0484-2375999

Shri. R. Madhu
Secretary : 0484-2377737

Government of India,
Ministry of Agriculture and Farmer's Welfare
P.B. No.1012, Kera Bhavan, SRV Road,
Kochi – 682 011, Kerala, India.
Email : kochi.cdb@gov.in
Website: https://www.coconutboard.gov.in
Office:0484-2376265, 2377267,
PABX : 2377266, 2376553, Fax:91 484-2377902

Regional Offices

KARNATAKA
Director, Regional Office, Coconut Development Board, Hulimavu, Bannerghatta Road (Beside Horticulture Farm, Govt. of Karnataka), Bangalore South Taluk, Bangalore - 560 076 Karnataka. Ph: (080) 26593750, 26593743 Fax: 080-26594768
E-mail: ro-bnglr@coconutboard.gov.in

ASSAM
Director, Regional Office, Coconut Development Board, Housefed Complex (Sixth Floor), Wireless Basistha Road, Last Gate, Dispur, Guwahati - 781 006. Assam.
Ph: (0361) 2220632
Fax: (0361) 2229794
E-mail: ro-guwahati@coconutboard.gov.in

TAMILNADU
Director, Regional Office, Coconut Development Board. No. 47, F1, Dr. Ramasami Salai K.K.Nagar, Chennai - 600 078
Ph: 044-23662684, 23663685
E-mail: ro-chennai@coconutboard.gov.in

BIHAR
Director, Regional Office, Phulwari Road, Jagdev path, Phulwari Road, Patna - 800 014, Bihar,
Phone: 0612-29720200
Email- ro-patna@coconutboard.gov.in

State Centres

ANDAMAN & NICOBAR ISLANDS
Dy. Director, State Centre, Coconut Development Board, House MB No.54, Gurudwara Lane, Near Head Post Office, Opp. BSNL Quarters, Port Blair - 744 101, South Andaman. Ph: (03192) 233918
E-mail: sc-andaman@coconutboard.gov.in

ANDHRA PRADESH
Dy. Director, State Centre, Coconut Development Board, D.No.4-123, Rajula Bazar Ramavarappadu PO, New Zilla Parishad High School, Vijayawada - 521108, Krishna District, Andhra Pradesh Telefax: 0866 2972723
E-mail: sc-vijayawada@coconutboard.gov.in

MAHARASHTRA
Dy. Director, State Centre, Coconut Development Board,Flat No. 203, 2nd Floor, Eucalyptus Building, Ghodbundar, Thane West - 400 610. Maharashtra.
Ph: 022-65100106
E-mail: sc-thane@coconutboard.gov.in

ODISHA
Dy. Director, State Centre, Coconut Development Board, Pitapally, Kumarbasta PO, District Khurda - 752 055 Odisha.
Ph: 8280067723,
E-mail: sc-pitapalli@coconutboard.gov.in

WEST BENGAL
Dy. Director, State Centre, Coconut Development Board, DA-94 - Sector - I, Salt Lake City, Kolkata - 700 064.
West Bengal, Ph: (033) 23599674 Fax: (033) 23599674
E-mail: sc-kolkata@coconutboard.gov.in

Market Development cum Information Centre
Asst. Director, Market Development cum Information Centre, Coconut Development Board, 120, Hargobind Enclave, New Delhi - 110 092.
Ph: (011) 22377805 Fax: (011) 22377806
E-mail:mdic-delhi@coconutboard.gov.in

CDB Institute of Technology (CIT), Technology Development Centre and Quality Testing Laboratory,
Dy. Director, Technology Development Centre, Quality Testing Laboratory and CIT, Coconut Development Board, Keenpuram, South Vazhakkulam, Aluva, Ernakulam District. Pin - 683 105. Kerala. Ph: (0484) 2679680
Email: cit-aluva@coconutboard.gov.in

Field Office Thiruvananthapuram
Coconut Development Board, Agricultural Urban Wholesale Market (World Market), Anayara PO, Thiruvananthapuram. Pin 695 029 Kerala Ph: 0471 2741006
E-mail: fo-tvprm@coconutboard.gov.in

Demonstration-cum-Seed Production (DSP) Farms

ANDHRA PRADESH, Asst. Director, DSP Farm, Coconut Development Board, Vegivada (Village) P.O, Tadikalapudi (Via), W. Godavari (Dist.) Andhra Pradesh - 534 452. Ph: 8331869886, E-mail: f-vegiwada@coconutboard.gov.in

ASSAM- Farm Manager, DSP Farm, Coconut Development Board, Abhayapuri, Bongaigoan, Assam - 783 384. Ph: 9957694242 Email: f-abhayapuri@coconutboard.gov.in

KARNATAKA - Farm Manager, DSP Farm, Coconut Development Board, Loksara P.O., Mandya District, Karnataka - 571 478 Ph: 08232 298015 E-mail: f-mandya@coconutboard.gov.in

KERALA - Asst. Director, DSP Farm, Coconut Development Board, Neriamangalam, Kerala Pin-686 693. Ph: (0485) 2554240 E-mail: f-neriamangalam@coconutboard.gov.in

ODISHA - Farm Manager, DSP Farm, Coconut Development Board, At Pitapally, Post Kumarbasta,District Khurda - 752 055, Odisha. Ph:8280067723, E-mail: f-pitapalli@coconutboard.gov.in

BIHAR - Farm Manager, DSP Farm, Coconut Development Board, P.O. Singheshwar - 852 128, Madhepura District, Bihar. Ph: (06476) 283015 E-mail: f-madhepura@coconutboard.gov.in

CHATTISGARH - Asst. Director, DSP Farm, Coconut Development Board, Kondagaon - 494 226, Bastar District, Chhattisgarh. Ph: (07786) 242443 Fax: (07786) 242443 E-mail: f-kondagaon@coconutboard.gov.in

MAHARASHTRA - Farm Manager DSP Farm, Coconut Development Board, Dapoli Village, Satpati PO, Palghar District, Pin - 401405, Maharashtra. Ph: (02525) 256090 Mob:07767948448 & 7776940774 E-mail: f-palghar@coconutboard.gov.in

TAMIL NADU - Farm Manager DSP Farm, Coconut Development Board, Dhali, Thirumoorthy Nagar PO, Udumalpet, Tamil Nadu 642 112 Ph: (04252) 265430 Email: f-dhali@coconutboard.gov.in

TRIPURA - Farm Manager, DSP Farm, Coconut Development Board, Hichachera, Sakbari PO, Via: Jolaibari, Sabroom, SouthTripura, Tripura Pin:799141 Ph: 03823263059 Email: f-hitchachara@coconutboard.gov.in

WEST BENGAL -Farm Manager, DSP Farm, Coconut Development Board, Fulia,1st Floor, Near SBI Bank, Fulia Branch, NH-34, PO Belemath, Fulia, Nadia, West Bengal, 741402. Phone: 03473-234002, E-mail- f-fulia@coconutboard.gov.in

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