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Message from the Chairperson's Desk

Dear readers,

Hearty Greetings from Coconut Development Board!

I am happy to share with the esteemed readers of Indian Coconut Journal that Coconut Development Board in its Annual Action Plan for 2019-20 will be concentrating more on the production of quality planting materials and area expansion in nontraditional areas. To start with, the Board has already given training to its technical staff on planting material production and hybridization.

Intensive campaigns and awareness programmes on scientific coconut cultivation and management of coconut gardens is planned across major coconut growing districts and blocks. Activities are also initiated for the formation of Technical Resource Personnel group for imparting trainings on productivity improvement. Preparation of short films on different aspects of coconut cultivation, processing and value addition is also in the pipeline.

The activities of the 11 Demonstration cum Seed Production Farms of the Board will be strengthened to produce high quality planting materials. In order to modernize farm activities, it is planned to have regular visits by scientific experts in the DSP Farms of the Board.

With an effort to rejuvenate the activities of the Farmer Producer Organizations (FPOs) in coconut sector, steps are being taken to link them to active entrepreneurs/ exporters and the details are already shared with the Coconut Producer Companies.

Coconut Development Board is committed to tap the potential of coconut as a crop of the future. Let all coconut farmers, FPOs and the scientific coconut community join together to fully explore the potential of coconut in the country.

V Usha Rani IAS
Chairperson

Planting Material Production in Coconut: Status and Strategies

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Introduction

Coconut, the most important of all cultivated palms, provides livelihood security to several millions of people across the world. It provides food, drink, shelter and materials for industries. Evolved and adapted along the coastal ecosystem in tropical world, coconut spread to other regions subsequently with human assistance and became part of human culture. Presently, coconut is cultivated in 11.91 million hectares in 94 countries producing 67128 million nuts (Asian and Pacific Coconut Community (APCC) Statistical Year Book 2015). The Philippines, Indonesia and India are the major producers, contributing about 74% of total world production. Coconut today is being positioned as a food, nutritional and high value crop rather than oil crop. It also provides services to environment by way of helping in soil conservation, offering wind break, responsible for establishing parks and reserves and by being most suitable for integrated farming systems.

Coconut is cultivated in India since ages and it plays an important role in the social, economic

Coconut is grown in many states in addition to the traditional coconut cultivating states. There has been expansion of area in all the states except in Kerala. In spite of area expansion, increase in production and productivity was negligible till the year 1985. Release of improved varieties from the year 1980 and development of production technologies resulted in the increase of production and productivity in coconut during the later part of 20th century.

and cultural activities of the people. It is cultivated in 18 states and three Union Territories in India. Through the systematic research conducted during the last century, a substantial number of viable technologies pertaining to improved varieties including hybrids, integrated nutrient management, water management and irrigation, multiple cropping and integrated farming, integrated pest and disease management and value addition through product diversification have been evolved for enhancing coconut productivity and profitability. But coconut farmers are not able to exploit the production potential from these technologies to the extent desirable due to various socio-economic, technological, infrastructure and other constraints. Major problems experienced by coconut growers include price crash/price fluctuation in the market, ever increasing cost of cultivation, fragmented holdings, predominance of senile and disease affected palms, lack of skilled climbers for harvesting and plant protection etc. Adoption of high yielding improved varieties is one of the important strategies for enhancing coconut productivity. However, the extent of adoption of improved varieties of coconut is very low and lack of availability of quality planting material of coconut is a major reason attributed for the low level of adoption of improved coconut varieties by the coconut growers.

Area, production and productivity

In India coconut is cultivated in 2.08 million ha with production of 23.9 million nuts and productivity of 11,481 nuts/ha The four southern states, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh account for 90% of area under coconut and 93% of production. Table 1 provides the details of area, production and productivity of coconut in India in the year 2016-17.

Area under coconut in India has shown an increasing trend over the past six decades realising 3.3 times of initial area, with an annual compound growth rate (ACGR) of 1.83%. Decadal growth rates show that area has increased with highest rate in 1961-70 and 1981-90 period whereas the decades 1971-80 and 2001-10 has shown a negative growth rate in area expansion mainly due to reduction in area in Kerala (9.05 to 7.7 lakh ha). Similarly, yield has shown a growth of 2.18 times that of the yield in 50's, with an overall growth rate of 1.18%. During 1961-70 and 1971-80, growth rate was negative and as represented graphically, there was no substantial increase in coconut yield till 1990. During the past 27 years, yield increase was almost double; 5992 to 11491 nuts per palm per year.

Coconut is grown in many states in addition to the traditional coconut cultivating states. There has been expansion of area in all the states except in Kerala. In spite of area expansion, increase in production and productivity was negligible till the year 1985. Release of improved varieties from the year 1980 and development of production technologies resulted in the increase of production and productivity in coconut during the later part of 20th century. But the improvement was not uniform across the states and it was also limited by the slow spread of improved varieties owing to the non availability of planting materials in required quantities. Some traditional coconut growing states like Tamil Nadu and Karnataka and new states like Gujarat have achieved productivity of above 10000 kg / ha, while states like Kerala is lagging behind (Table 1).

Table 1. Area, production and productivity of coconut in India (2016-17)

Sl No.	States / Union Territories	Area ('000 hectares)	Production (million nuts)	Productivity (nuts/ha)
1	Andhra Pradesh	115.21	1,377.53	11,957
2	Assam	20.60	153.27	7,440
3	Bihar	14.90	141.09	9,469
4	Chhattisgarh	1.48	8.77	5,926
5	Gujarat	24.44	336.65	13,775
6	Karnataka	513.85	6,773.05	13,181
7	Kerala	770.79	7,448.65	9,664
8	Maharashtra	20.90	198.85	9,514
9	Nagaland	0.47	2.67	5,681
10	Odisha	50.91	341.68	6,711
11	Others	52.76	142.38	2,699
12	Tamil Nadu	461.06	6,570.63	14,251
13	Telengana	0.50	2.09	4,180
14	Tripura	4.61	32.23	6,991
15	West Bengal	29.63	374.56	12,641
	Total	**2,082.11**	**23,904.10**	**11,481**

(Source: Horticulture Division, Dept. of Agriculture & Cooperation, Ministry of Agriculture & Farmers Welfare, Government of India).

Reluctance to replace old, unproductive and senile palms with improved varieties, coupled with scarcity of quality planting materials, is the major

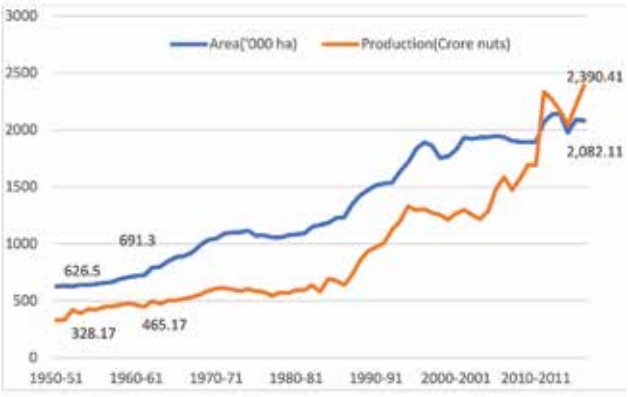


Fig 1. Area (000 ha) and Production (crore nuts) of coconut in India (1951-2017)

reason for low productivity in traditional areas.

The changing scenario has created a huge demand for coconut planting material, but has worsened the already strained environment of planting material production and distribution, opening avenues for unscrupulous elements to exploit the situation by pushing dubious seedlings. The situation warrants development of strategies to improve the availability of quality planting material and to develop a mechanism to check the quality of the material in distribution chain. Analysis of present scenario of planting material production in coconut in the country is a pre-requisite for developing such strategies.

Improved varieties for enhancing productivity

The most important input for increasing productivity is cultivation of high yielding varieties. Traditional or local varieties in coconut yield up to 9000 Kg/ha of husked nuts and 15 Kg copra/palm. Improved varieties have the potential to give yield up to 15000 Kg/ha of husked nuts and 25 Kg copra/ palm. By cultivating improved varieties, farmer can realize an additional 6000 Kg/ha of husked nuts or an additional 10 Kg of copra/ palm. In coconut, research on development of new varieties has received due attention from the very beginning. Germplasm collections from exotic and indigenous sources have enriched the diversity available for developing new varieties.

Fig 2. Annual Compound Growth Rate ACGR (%)

Decade	Area	Production	Yield
1951-60	1.30	3.44	2.11
1961-70	3.76	3.10	-0.64
1971-80	-0.05	-0.30	-0.25
1981-90	3.33	5.03	1.64
1991-00	1.78	2.32	0.53
2001-10	-0.19	2.71	2.91
2011-17	0.09	0.39	0.30
Overall	1.83	3.04	1.19

Many varieties have been developed by selection from exotic and indigenous collections. Discovery of heterosis, research on combining ability and evaluation of various cross combinations have lead to development of many hybrids. ICAR-CPCRI, ICAR-CIARI and State Agriculture Universities, which are the main agencies involved in coconut research have so far developed 49 varieties which include 29 high

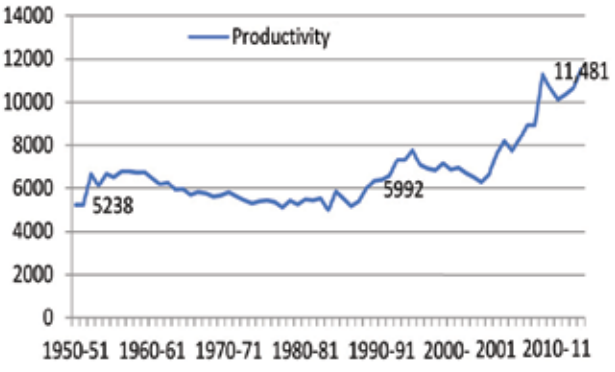


Fig 3. Productivity (nuts/ha)

yielding selections consisting of 11 Dwarfs and 18 Talls and 20 hybrids (8 DxT and 12 TxD combinations). Sixteen varieties have been recommended for tender nut purposes, 35 varieties for copra, six varieties for dual purposes and three for ornamental purposes (Table 2).

Table 2. Improved coconut varieties by different research organizations in India

Agency	Tall Variety	Dwarf Variety	Hybrid Variety	Total
ICAR-CPCRI, Kasaragod	8	5	6	19
ICAR- CIARI, Andaman		4		4
KAU, Kerala	1	1	5	7
TNAU, Tamil Nadu	3		4	7
ANGRU, AP	1	1	1	3
AAU, Assam	1			1
IGAU, Chhattisgarh	1			1
BCKV, West Bengal	1			1
UHS, Bagalkot	1		1	2
BSKKV, Maharashtra	1		1	2
Dr. YSRHU, AP			2	2
Total	**18**	**11**	**20**	**49**

In public sector including CDB, ICAR-CPCRI, SAUs and State Agriculture Departments, 630 ha land is being utilized for seed garden. It is possible to have one lakh mother palms that can supply five million quality planting material by fully utilizing these seed gardens.

Spread of improved coconut varieties

Impact of new varieties on national productivity is possible only when the varieties spread to large areas. In coconut, spread of new varieties has been limited due to various factors. A study on the spread of hybrid varieties has revealed that coconut hybrids were cultivated only in 14 per cent of the farmer gardens in Kerala. Many of these gardens had only two or three hybrid palms. Lack of availability of planting materials of hybrids was often cited as a major constraint in adopting coconut hybrids (Thamban and Venugopalan, 2002).

Coconut is a long duration crop, giving economic yield up to 70 to 80 years. But, initial flowering and stabilization of yield take 5-7 and 10-12 years in dwarfs and talls respectively. This long juvenile period slows down the multiplication of planting material. A 10 year seed to seed time means that new mother palm population of a variety is possible only after a gap of 10-14 years. The long juvenile period in coconut has greatly reduced establishment of mother palm gardens with new varieties. Another impediment in coconut seed production is the low number, approximately 50, of planting material possible from a mother palm per year. This reduces the multiplication rate of new varieties. As a consequence of all these factors, spread of a new variety possible in the first 10 years is 0.25 ha/annum/mother palm. Initial number of mother palms available at the time of release of a new variety determines the quantity of planting material possible and speed of spread of the variety. In the case of hybrid varieties, production of planting material requires skilled climbers well versed with hybridization techniques. Shortage of such skilled workers call for capacity building of climbers by providing training in hybridization technique.

The major constraint in the production of quality planting material is the limited availability of mother palms. If a variety is released with 100 mother palms, it can spread to 250 ha during the first 10 years, which is only 0.01% of total area under coconut in India. In coconut, variety development process is limited by area available for evaluation. Hence, most of the time, evaluation is carried out with limited number of palms ranging from 12 to 36 palms. In the case of varieties developed through selection, these are the only mother palms once the new selection is released. In the case of hybrid variety development, number of mother palms of a specific hybrid is even more limited as only 4-5 palms are required for initial development of a combination. In all the hybrids, dwarf coconut cultivar is one of the parents and the numbers of these dwarf palms are very much limited. Limited number of mother palms available with the agencies developing new varieties has been the major cause of low spread. There is a need to specify minimum number of mother palms required for releasing a new variety.

Research agencies responsible for developing

new varieties need to have a plan for scaling up the planting material production. Planting advanced lines or promising lines in nurseries and farms under public sector will improve the availability of mother palms when these lines are released as new varieties. Another approach can be the farmer participatory

evaluation where advanced lines or promising lines are evaluated on farm. Mother palm blocks of released varieties can be established in nurseries under public and private sector as long term strategy to improve the availability of planting material.

Strengthening functional linkages between research and development agencies under public sector is required to operationalize the planting in advanced lines and establishing mother palm blocks of released varieties in nurseries and farms under public sector. Infrastructure available with the development agencies and the technical know-how with the research agencies need to be synchronized for the benefit of farming community.

Seedling requirement and present status of production in the country

Coconut is cultivated in 2.16 million ha land in India. Approximately 350 million palms are in the field. Replacement of 2.5% of total palms in the field annually requires 8.75 million seedlings. Additional 1.75 million seedlings are required annually to meet the demand for replanting 0.4 million ha in root (wilt) affected areas. National average area expansion in coconut is about 23,300 ha per annum. Approximately four million seedlings are required annually for covering the area expansion. Altogether, 14.5 million seedlings are required annually to meet the planting material demand in coconut. In an earlier study, Rethinam (2002) estimated that 15 million seedlings are required in coconut annually. An expert committee constituted by CDB in 2005 reported that the annual demand for coconut seedlings will be 13.9 million (CDB, 2005).

Coconut seedlings are produced and distributed by ICAR-CPCRI, CDB, SAUs and State Agriculture Departments from public sector, and a few nurseries, from private sector. Public sector contribution is about 4.2 million seedlings only (Table 3). It is projected that another four million seedlings comes from private nurseries and farmers.

Table 3. Seedling production under public sector

Agency	**No. of seedlings**		
ICAR-CPCRI	1,08,085		
CDB	9,00,000		
State	**University**	**Department**	**Total**
Kerala	126758	637979	764737
TamilNadu	81099	1004000	1085099
Karnataka	18676		18676
Andhra Pradesh	19978		19978
Maharashtra	104207	28274	132481
Assam	5000		5000
Gujarat	18300	82199	100499
Odisha	876	1030000	1030876
West Bengal		16000	16000
Total	**374894**	**279852**	**41,81,431**

The major constraint in enhancing production under public sector is the limited number of mother palms available with them. Many seed gardens established are facing various problems that have resulted in further reduction in number of palms. Rejuvenation of these seed gardens by planting mother palms of newly released varieties require immediate attention. Present status of mother palm availability is given in the Table 4. In public sector including CDB, ICAR-CPCRI, SAUs and State Agriculture Departments, 630 ha land is being utilized for seed garden. It is possible to have one lakh mother palms that can supply five million quality planting material by fully utilizing these seed gardens.

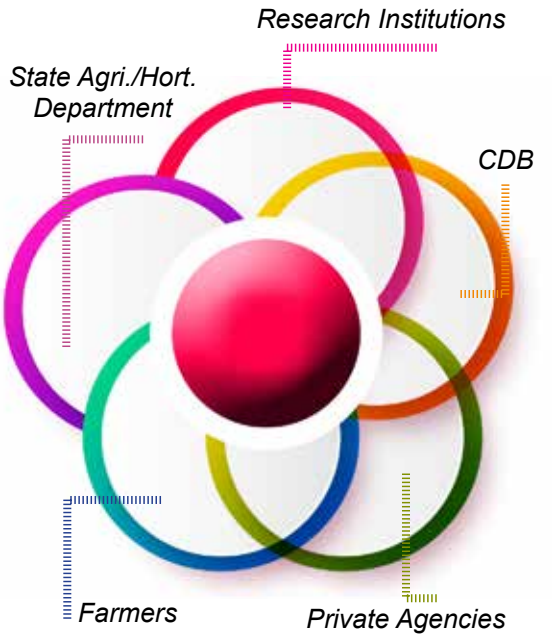
Table 4. Availability of mother palms of released varieties with public sector			
Tall Variety	**Numbers**	**Dwarf Variety**	**Numbers**
WCT	10666	Gauthami Ganga	411
ECT	4443	Kalpa Jyothi	704
LCT	1297	COD	2614
Kerachandra	121	Kalparaksha	302
Kamrupa	150	Kalpasurya	292
TPT	390	Kalpasree	219
Kera Bastar	179		
Pratap	51		
Sakhigopal	602		
ADOT	98		
Kalpa Pratibha	48		
Kalpa Mitra	43		
ADGT	20		
Kalpa Haritha	45		
Total		Total Mother palms	27810

The existing nursery infrastructure can be strengthened by planting mother palms of varieties suitable for respective agro-eco zones. Research agencies developing varieties should make breeder's seed seedling available for such planting on priority.

Quality control in planting material production

The quality planting materials available in the country from various sources in public and private are insufficient to meet the estimated demand. This has always forced farmers to use any material available for planting thereby opening a wide gate for spurious material to enter. Absence of any quality control of planting material distributed has made it easier for the unscrupulous elements to operate. In order to bridge the gap in demand and supply in planting material production, CDB has initiated certain measures like involving farmer organizations for planting material production. These initiatives need to be supported with infrastructure to check the quality, adherence to released varieties and linkage with research institutes for technical support. There are a few nurseries in the private sector catering to the need of farmers by producing planting material. National Horticulture Board has started accreditation process that grades the nurseries in a scale of five stars. Certification of planting material and registration of mother palms along with labeling of planting material is needed to ensure the quality.

Strengthening the Linkage Among all Stakeholders



Linkage among various stake holders

Planting material production is addressed by various agencies like ICAR-CPCRI, CDB, SAUs, State Agriculture Departments, private nurseries and farmers. These agencies are facing many issues ranging from mother palm availability, land requirement, shortage of trained manpower to varietal identity and seedling quality. Research institutes are strong in technology development and possess expertise for planting material production but their capability in production and distribution of planting material is limited. Development agencies are strong in production and distribution of planting material but lack in expertise in technology. Private enterprises and farmers need to be more conscious about seedling quality and adherence to varietal identity. Linkage and cooperation among all the agencies involved are essential to bring quality and quantity changes in the scenario (Fig. 4).

Way forward

There is a need to strengthen the available nursery infrastructure with mother palms suitable to generate required quantity of quality planting material of the recommended variety for the respective agro-eco

Shri. Narendra Singh Tomar takes charge as the Hon'ble Union Minister of Agriculture and Farmers Welfare

Shri. Parshottam Rupala and Shri. Kailash Choudhary are the Hon'ble Union Ministers of State for Agriculture

Shri. Narendra Singh Tomar

Shri. Kailash Choudhary

Shri. Narendra Singh Tomar took charge as the Hon'ble Union Minister of Agriculture and Farmers Welfare, Rural Development and Panchayati Raj. He is elected as the Member of Parliament from Morena (Madhya Pradesh) Lok Sabha constituency. During the 16th Lok Sabha period from 2014 to 2019, he served as the Union Minister of Steel, Mines, Labour and Employment and later took charge as the Minister of Panchayati Raj, Rural Development and Drinking Water & Sanitation. Shri. Tomar is a native of Murar village in Gwalior district of Madhya Pradesh and graduated from Jiwaji University.

Shri. Parshottam Rupala

Shri. Parshottam Khodabhai Rupala has sworn in as the Union Minister of State for Panchayati Raj, Agriculture and Farmers Welfare. He is a Member of Rajya Sabha representing the State of Gujarat and was a former Member of Gujarat Legislative Assembly from Amreli. He has served as Minister in the Government of Gujarat.

Shri. Kailash Choudhary also took charge as the Union Minister of State for Agriculture and Farmers Welfare. He is a Member of Parliament from Barmer Lok Sabha constituency and was a former Member of the Rajasthan Legislative Assembly representing the Baytoo Vidhan Sabha constituency.

zones. Research agencies need to concentrate more on production of breeder seeds and in establishing mother palms of released varieties. Decentralized evaluation for varietal development involving farmers, government and private agencies will help in improving mother palm availability once the material is released. Rejuvenating mother palm blocks of existing seed gardens and nurseries under public sector need coordinated efforts. Expanding nursery infrastructure under public sector by establishing new nurseries especially in non-traditional areas is required for meeting the future requirement. Seed certification including mother palm registration and seed labeling coupled with regulatory mechanism to check the quality of planting material is essential to improve the situation. Creating common platform for planning, monitoring, regulatory mechanisms etc. at the national level will help the cause. ■

Reproduced from the handbook on Enhancing Productivity in Coconut - Quality Planting Material and Agro-Techniques, ICAR- CPCRI, Kasaragod-671 124, Kerala, India.

Nutrient Management in Coconut for Sustaining Productivity

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Coconut, the tree of life ('Kalpa Vriksha') is indeed a boon to mankind by being bestowed with the innate potential to supply food, feed, fiber, health drink, building material and thus forming an inevitable component of our daily life. In terms of its life cycle, coconut palms may sometimes outlive humans and will be having a production period of 6 to 8 decades. During this period, the potential productivity of the palm can be extracted to the fullest extent only if the nutrient removal through the nut harvest as well as due to the removal of crop residues are adequately replenished.

Nutrient requirement of coconut

Among the seventeen essential nutrients required universally for the growth of all the plants, the nutrients which are of great importance for coconut are nitrogen(N), potassium(K), calcium(Ca), magnesium(Mg), sulphur(S), phosphorus(P),Chlorine (Cl) and boron(B). Based on a study conducted at ICAR-CPCRI Regional Station, Kayamkulam, it has been found that the magnitude of nutrient uptake in an apparently healthy adult palm is of the order

> **Food is vital for every living thing and coconut palms being a perennial plantation crop require balanced nutrition to compensate for the nutrients which are lost from the system through the harvest of nuts as well as through palm residues.**

889 gram nitrogen 389.7 gram calcium, 1075 g potassium, 71.6 g magnesium, 229.69 g sulphur, 321.63 mg boron, 2304 mg zinc, 569 mg copper and 1784 mg manganese. Among all the nutrients, potassium leads in the fore front in the total nutrient uptake by an apparently healthy palm. Seventy four per cent of the total potassium is stored as reserve biomass (stem) whereas the amount stored in the recyclable biomass (palm components which can be recycled back to the soil) constitutes 24 per cent of the total potassium uptake. Hence it can be seen that considerable quantity of nutrients are being stored in the biomass of coconut.

In a healthy soil, the optimum rate of available nitrogen, phosphorus and potassium is 280-560 kg/ha, 10-25 kg/ha and 110-280 kg/ha respectively. The content greater than 300 ppm, 120 ppm and 5 ppm is the optimum requirement of calcium, magnesium and sulphur in a healthy soil. In the case of micronutrients such as zinc, copper and manganese, the soil content less than 1 ppm is considered to be deficient. The boron content less than 0.5 ppm in the soil is deficient where as the content less than 5 ppm is considered to be deficient with regard to iron.

Role of nutrients on coconut productivity

Food is vital for every living thing and coconut palms being a perennial plantation crop require balanced nutrition to compensate for the nutrients which are lost from the system through the harvest of nuts as well as through palm residues. It is also mandatory to apply the right quantity of the nutrients at the right time and in the right proportion. Both the condition of excess nutrition as well as under nutrition is hazardous in terms of antagonistic nutrient interaction as well as hindered crop nutrient uptake. Hence it is appropriate to understand the role of individual nutrients on the growth and productivity of coconut.

Primary Nutrients (Nitrogen, Phosphorus and Potassium)

Nitrogen is a constituent of amino acids, proteins and nucleic acids. The pyrole rings constituting the porphyrin structure of chlorophyll and other bio molecules contains nitrogen in them. Being the main component in soil organic matter, soils which are organically poor as well as that of reclaimed soils encounter the deficiency of nitrogen. However prevalence of water logged condition will result in the loss of available nitrogen and thereby causes the exhibition of nitrogen deficiency symptoms in coconut palms. Stunted growth and chlorotic leaves of seedlings are common in nitrogen deficient soils. Nitrogen promotes the uptake of phosphorus and potassium and hence the deficiency of nitrogen will hinder the uptake and assimilation of other nutrients as well. In addition to these factors, application of organic manures having a wide C:N ratio as that of poultry manure may result in the temporary locking up of nitrogen and result in nitrogen deficiency particularly in young palms.

The general symptom of nitrogen deficiency (figure 1.) is the reduction in chlorophyll content with golden yellow coloration of older leaves near the petioles and light brown colour near the end, which later dries out. Yellowing starts from the tip of the leaf and leaflets progresses along the midrib. The peculiarity of nitrogen deficiency is that mid rib also turns yellow.

Fig1 Nitrogen deficiency symptom in coconut

The deficiency can be managed through the application of nitrogenous fertilizers depending on the soil test data. Prevalence of water logged condition should be avoided to prevent the gaseous loss of applied nitrogen. Recommended dose of organic manure should also be applied to maintain the organic matter status in soil.

Another major nutrient involved in coconut nutrition is phosphorus. Being a component of nucleic acid, and its involvement in the energy transfer and cell respiration, it is a vital nutrient for the growth of all plants. In coconut, phosphorus nutrition is essentially important for the growth of young palms particularly for the root proliferation and development. Initial flowering is greatly influenced

Fig 2 Phosphorus deficiency in coconut

by the availability of phosphorus. Moreover, for the efficient functioning of nitrogen, phosphorus supply in the requisite amounts need to be ensured. Ensuring the availability of soil phosphorus is required for the proper establishment of juvenile palms. The deficiency of phosphorus is commonly encountered in laterite soils as well as in extremely acidic (pH less than 4.5) and calcareous soils. Under conditions of phosphorus deficiency, there will be restricted root growth. In the leaves, deficiency symptoms are manifested as purplish discoloration (Fig.2.). Phosphorus deficiency can be managed by the application of recommended dose of phosphatic fertilisers.

However, continuous application of phosphatic fertilisers may result in the buildup of available phosphorus in the soil. This situation will result in the reduced availability of micronutrients particularly zinc and boron. If the level of available phosphorus in soil determined through systematic soil analysis in soil testing laboratories is greater than 20 ppm, application of phosphatic fertilisers can be skipped for the next two years and later it can be resumed depending on the availability in soil.

Potassium is the key nutrient in coconut production systems and is removed in the greatest proportion from coconut. Apart from imparting resistance to the attack of pests and diseases, potassium also confers abiotic stress tolerance particularly drought. It regulates the opening and closure of stomata and thereby regulates the water balance in the plant system. It is necessary for the formation of sugar, fat and fibrous material. It also has a role in the production of female flowers and nut setting. Being 'Kalpa Vriksha', all the palm parts

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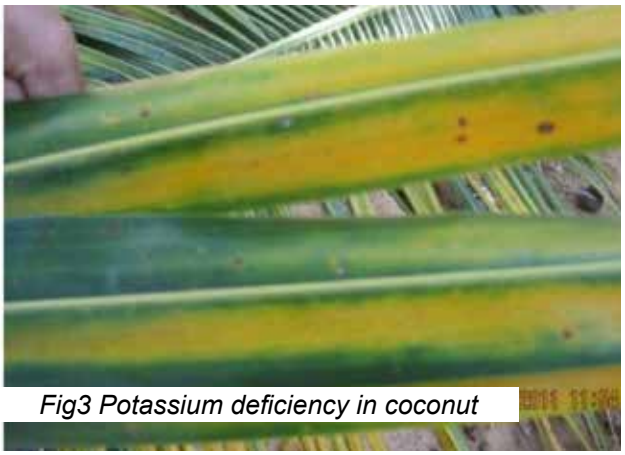

Fig3 Potassium deficiency in coconut

are effectively utilized for various purposes. Hence if the nutrients which are removed from the system through these palm components are not replenished, nutrient deficiency symptoms will occur in the palm.

Soil conditions such as over liming, excess application of magnesium sulphate and soil acidity trigger the occurrence of potassium deficiency in coconut palms. Light sandy soils with low cation exchange capacity and less organic matter are more prone to the occurrence of potassium deficiency symptoms in coconut. In this regard, it should be considered that while intercropping of potassium exhaustive crops such as tuber crops, fodder grass, banana and pineapple in coconut gardens, they should be grown by giving adequate fertilizers based on the requirement of the individual crops.

During potassium deficiency, there will be orangish discoloration in the outer leaves and the occurrence of orange colored spots (Figure 3). The discoloration starts from the tip of the outer leaves and progresses along the margin towards the base. But the mid rib portion remains green. Leaf tip becomes withered and necrotic. Later the necrotic spots join together giving a scorched appearance. The appearance of a

green triangle with the base in the lowest leaflets and apex towards the tip is a characteristic feature of potassium deficiency in coconut. Addition of soil test based potassium fertilizers along with the recycling of palm residues in the basin help to overcome its deficiency.

Secondary nutrients (Calcium, Magnesium and Sulphur)

In coconut nutrition, straight fertilizers are often applied at the recommended doses, but over exhaustion from the soil due to crop removal coupled with the ever aggravating problem of soil acidity can result in the deficiency of secondary nutrients such as calcium, magnesium and sulphur.

Calcium is the base nutrient ion associated with the imparting of turgidity and vigor to the leaves. It is essential for the developing tissues and cell wall development. Acidic soils contain low calcium and continuous crop removal can result in the deficiency of calcium. Calcium is an immobile element in plant and the deficiency symptoms first appear on the youngest leaves. Calcium deficiency in coconut palms are manifested as loss of vigor and turgidity in the youngest tissues, necrosis and death of the bud. Under conditions of calcium deficiency, spraying 0.5% calcium nitrate solution is recommended. Lime application@ 1 kg per palm two weeks prior to fertiliser application will supply calcium to the soil.

Being the central ion in chlorophyll, magnesium has a definite role in the pigment system and affects the photo synthetic capacity of the plant. It also enhances the production of female flowers and activates several enzyme systems in the plant. In the case of deficiency, yellowing of the older leaves start from the tip and extend towards the base and later the younger leaves also turns yellow (Fig. 5). Magnesium deficient leaves have distinctly green leaf centres and bright lemon yellow to orange margins. Yellowing occurs principally in those parts of the leaf which are exposed to sunlight. In most of the cases, the shaded part remains green.

Magnesium deficiency can be managed by the application of magnesium sulphate@ 500g per palm during the application of second dose of fertilizers.

Another important secondary nutrient for coconut is sulphur. Sulphur is required for the formation of oil and improves the quality of oil and copra. It also improves the nut characters. During sulphur deficiency, yellowing initiates on the youngest leaves with older leaves remaining green. Leaves droop as the stem becomes weak. In older palms, leaf number and size are reduced. Group of dead fronds develops around the stem due to weakness of the rachis. Nuts may fall prematurely. Rubbery copra is a characteristic symptom of sulphur deficiency in coconut.

Fig 4 Calcium deficiency in coconut

Micronutrients

Boron is an essential micronutrient for coconut, which helps in the multiplication of meristematic tissues. It helps in the metabolism of protein, synthesis of pectin, maintenance of water relation, translocation of sugars, tissue respiration, fruiting process, growth of pollen tube and in the development of flowers and fruits. Wide spread deficiency of boron is noticed in the coconut growing areas which is attributed mainly to the continuous removal through cropping, and also due to the non replenishment of the same along with regular fertilizer application.

The deficiency symptoms of boron appear on the leaves, roots, inflorescence and nuts. Since boron is an immobile element in plant, the first symptoms appear on the youngest leaf. Meristematic tissues are seriously affected by boron deficiency. Fasciation ie., the failure of the leaves to split open is the major foliar symptom of boron deficiency and is referred as 'crown choke disorder'. There will be crinkling and reduction in elongation of young leaves (Figure 6). Pollen production, pollen grain germination and

pollen tube development will be adversely affected. There will be poor nut setting and button shedding will be rampant. In certain conditions, occurrence of 'Hen and chicken disorder' wherein both old and young nuts occur within the same bunch is also noticed.

Mathew *et al.* (2018) found the critical boron level in coconut leaf as 13.27 mg/kg and that in soil as 0.48 ppm. The critical level indicates the level of boron in soil and leaf below which deficiency symptoms appear and above which toxicity symptoms will occur. Boron deficiency in coconut can be managed by the application of 40 g each borax during June, September, December and March along with organic manures. Irrigation is to be ensured for greater use efficiency of added boron. It is also mandatory to correct the acidic soil reaction by the addition of dolomite@ 1 kg per palm before the application of borax.

Iron is a catalyst for the formation of chlorophyll and is also a constituent of enzymes associated with respiration and oxidation systems. Iron gets precipitated in the non available forms under alkaline and calcareous soils and under conditions of excess phosphorus there will be fixation of iron as insoluble phosphates. Under acidic soil conditions, deficiency of iron is usually not encountered.

Uniform chlorosis is the symptom associated with iron deficiency. All the leaves from the top of the crown to the base will have a pale green or dark yellow discoloration. There will be gradual yellowing of the leaflets in longitudinal strips parallel to the veins. In the advanced stages the leaf becomes completely yellow. There will be shortening of the rachis and the leaflets. Absence of necrosis in any part of the leaf is a characteristic symptom of iron deficiency.

As in the case of iron, deficiency of manganese also occurs in alkaline and calcareous soils with pH greater than 7.0. Manganese deficiency is caused primarily by high soil pH. Mild manganese deficiency symptoms include, new leaves emerging chlorotic with longitudinal necrotic streaking. The base of this leaf shows the curling or frizzling which is characteristic of more severe manganese deficiency.

The deficiency of copper is seen in highly acid sandy soils and in heavy organic soils, as well as in highly calcareous and alkaline sols. Liming reduces the availability of copper in deficient soils. Severe bending of the rachis of the youngest leaves, accompanied by yellowing and desiccation of the

Fig5 Magneisum deficiency symptoms in coconut

leaf tip which is rimmed with brown and yellow and the central part remain green. As the symptoms develop, dried out part spreads and gives the palm a saggy appearance.

Zinc catalyses oxidation in plant which is and is essential for the transformation of carbohydrates, helps in the formation of auxins, and promotes the water absorption. Button shedding along with the shortening of the crown is the reported symptom of zinc. Zinc deficiency is characterized by formation of small leaves wherein the leaf size is reduced to 50%. Leaflets become chlorotic, narrow and reduced in length. In acute deficiency, flowering is delayed.

Chlorine is associated with the stomatal conductance and the maintenance of water balance. The deficiency of chlorine is seen in the palms located in the inland areas. There will be reduced growth rate of the palms with reduction in size and number of nuts. Leaves will be droopy and indicates signs of moisture stress which may result in the breakage of fronds. There will be stem cracking and frequent occurrence of stem bleeding. Marked incidence of grey leaf blight is also reported.

The visual symptoms are observed when the palm has already been affected by the deficiency of the particular nutrient. Hence it is better to periodically monitor the soil and palm health through systematic soil as well as through leaf analysis.

Strategies for balanced nutrition in coconut

As nutrition plays a vital role on sustaining palm health and productivity, suitable management strategies are to be adopted from the initial years onwards. The care and management attributed in the juvenile stages are indeed reflected in the productivity of the palm at later stages. Hence systematic nutrient management strategies are to be adopted for exploiting the palm production potential to the fullest extent.

Correcting Soil Reaction

For the efficient use of applied nutrient inputs, soil pH should be in the range of 6.0 to 6.5. In acidic soil pH can be corrected by the application of lime or dolomite@ 1 kg per palm two weeks prior to the application of fertilizers. Dolomite is the carbonate of calcium and magnesium. The liming materials should also be thoroughly mixed in the soil. Presence of adequate soil moisture is essential for ensuring the chemical reaction in soil for correcting the soil acidity by liming.

Integrated nutrient management in coconut

Nutrient removal by the palm depends on the stage of growth of the palm as well as soil fertility status. Under Kerala conditions, the nutrient recommendation for the adult palm is 500: 320: 1200 gram N: P_2O5: K_2O, which can be supplied through 1 kg urea, 1.5 kg mussoriephos and 2 kg muriate of potash. The entire fertilisers can be applied in two splits depending on the availability of rains. 1/3rd of the recommended dose of fertilisers can be applied in the beginning of the South West Monsoon and the remaining 2/3rd fertilisers can be applied by the time of the North East monsoon during September-October. The fertilisers can be broadcasted around the palm by taking basins at a radius of 1.8 meter and 25 cm depth and mixed thoroughly during May – June. During the second split of fertiliser application, basins can be closed with the incorporation of 25kg organic manure.

The first dose of fertiliser is to be applied 3 months after planting @ 1/10th of the dose recommended for the adult palms. One year after planting 1/3rd of the adult palm dose is required and two years after planting 2/3rd of the adult palm dose is to be applied. From the third year of planting onwards, full dose as recommended can be applied.

In Tamilnadu, manuring is done in two equal splits during June-July and December-January. Phosphatic fertilisers are applied as superphosphate in the basins or as Di Ammonium Phosphate through drip irrigation when the quality of irrigation water is good. Under irrigated conditions, the fertilisers can be applied in 3-4 split doses. The fertiliser recommendation for coconut in Kerala, Tamil Nadu and Karnataka are presented in Table 1.

Table 1. Nutrient recommendation for coconut

Stage of the palm	Organic manure	Urea	Mussoriephos	Muriate of potash
	kg/palm	g/palm /year		
Kerala				
3 months after planting	5	100	160	200
1 year after planting	5	360	535	668
2 year after planting	10	720	1065	1300
3 year after planting onwards	25	1000	1600	2000
Tamil Nadu				
6 month after planting	10	-	-	-
1 year after planting	20	304	400	500
2 year after planting	30	608	800	1000
3 year after planting	40	911	1200	1500
4 year after planting	50	1215	1600	2000
Karnataka				
3 months after planting	20	109	200	225
1 year after planting	20	347	600	676
2 year after planting	20	716	1200	1350
3 year after planting onwards	50	1085	1600	2000

*(Source: **1**. Coconut Cultivation Practices. 2007.ICAR- Central Plantation Crops Research Institute, Kasargod, Kerala. Eds. (Dhanapal, R., Thampan, C).Extension Publication No. 179.p.26. **2**.http://www.agritech.tnau.ac.in/expert_system/coconut/coconut_mainfield.html) **3**. Package of Practices Recommendations, University of Agricultural Sciences, Bengaluru*

Fig6 Boron deficiency symptoms in coconut

Microbes aid coconut biomass recycling

Agro residues from coconut gardens constitute a huge biomass (12-14 t/ha/annum) of lingo cellulosic nature partly recalcitrant to microbial degradation. Coconut leaves, husk and coir pith form mulching materials in basins. Mulching is to done at the end of monsoon and thus helps to conserve moisture, to maintain ambient soil temperature and to encourage microbial activity in the root zone thereby enabling the crop to withstand harsh summer. Before the onset of next monsoon, brittled mulch along with farmyard manure can be incorporated into the soil. Once sufficient moisture is received, microbial decomposition is initiated and continued involving succession of diverse microbial groups and function. Soil microbes create humus (by degrading organic matter) that are described as the 'life force of soil'. Humus helps soil to retain moisture and encourages crumb structure formation thus making the soil more porous. Mechanical shredding of leaves and techniques like coconut leaf vermicomposting and coir pith composting accelerates biodegradation of agro residues of coconut gardens. Apart from rapid decomposition, composting methods results in an increase in the population of beneficial microbial communities such as free-living nitrogen fixers, phosphate solubilizers, fluorescent pseudomonas and silicate solubilizers resulting in enhanced plant growth.

Microbes enhance nutrient availability in coconut

Plants are not capable of fixing atmospheric di nitrogen into ammonia and expend it directly for its growth. Thus the atmospheric nitrogen is converted into plant utilizable forms by biological nitrogen fixation (BNF). Beijerinckia, Azospirillum,Herbaspirillum, Burkholderia, Azoarcus, Bacillus are a few common nitrogen fixing bacteria associated with coconut roots. Most of these are effective bio inoculants for better establishment of coconut nursery seedlings.

Plant growth promoting rhizobacteria (PGPR) are known to improve plant growth. Most of the coconut rhizobacteria cultured from different coconut growing tracts of India belonged to Pseudomonas, Bacillus, Enterobacter and Actino bacter etc exhibiting multiple plant beneficial traits.

Some heterotrophic bacteria and fungi are known to have the ability to solubilize mineral nutrients like phosphate, potassium, zinc and silicate from insoluble sources and making them available to plants. Eg. Pseudomonas sp., Enterobacter sp., Acinetobacter sp., Bacillus sp., Micrococcus sp., Coryne bacterium sp. and Alcaligens sp. are the common nutrient solubilizers encountered in coconut plantation soils. Aspergillus sp. and Penicillumsp. are two predominant phosphate solubilizing fungi occurring in the coconut rhizosphere. These microbes produce organic acids such as gluconic acid and others that help in dissolution of insoluble nutrients. Soil application of biofertilizer formulation of nitrogen fixing bacteria, Azospirillum brasilense and phosphate solubilising bacteria, Bacillus subtilis @ 100 g per palm per year along with organic manures is recommended.

Plant growth promoting rhizobacteria (PGPR) are known to improve plant growth. Most of the coconut rhizobacteria cultured from different coconut growing tracts of India belonged to Pseudomonas, Bacillus, Enterobacter and Actino bacter etc exhibiting multiple plant beneficial traits. 'Kera Probio' is a talc based bioinoculant containing PGPR- Bacillus megatherium suitable for biopriming coconut and vegetables seedlings.

The symbiotic association between mycorrhizal fungi and the roots by Arbuscular Mycorrhizal (AM) fungi increase the surface area of a plant root system helping plants to absorb more water and improving

nutrient uptake like phosphorus (P), nitrogen (N), and micronutrients.

Eg. A soil based AMF bioinoculant, 'KerAM' containing Claroideo glomusetunicatum, one of the dominant sp. from coconut rhizosphere has been released, the application of which improves nutrient and water absorption in coconut seedlings.

Legumes as a component for basin fertility enrichment

Symbiotic association of N fixing bacteria (Rhizobium) with legume crops such as cowpea, mimosa and sun hemp is also being explored for enhancing nitrogen availability in coconut gardens. For utilizing the positive effect of leguminous crops, sowing of 100 gram cowpea seeds after the addition of first dose of fertilizers is required. With the initiation of flowering by one or two plants, they can be incorporated to the basin. Basin management of coconut by growing legume crops helps in producing 15-20 kg green manure/basin and their incorporation provides around 100-150 g N/palm along with other major nutrients. By growing legumes in interspaces of 1 ha coconut garden, 15 to 20 tons of fresh biomass can be incorporated in soil.

Irrigation

One of the critical resources in coconut production is the availability of water. Water is the medium for absorption of plant nutrients. For all physiological process within the plant including photosynthesis water is essential. There is constant upward movement of water from soil solution through the roots of palms under transpiration pull. Sufficient water should be available in the root zone to maintain plant functions and productivity. Though the coconut growing regions in the coastal belt are endowed with high rainfall, the rainy period is confined to a few months during the monsoon season. The palm experiences moisture stress and drought conditions for varying periods extending up to 6-7 months in a year which affects productivity. In the coconut growing region other than the coastal belt coconut has to be grown throughout the year by supplemental irrigation. When irrigation water is delivered through hose pipes, about 500 litres water is required to be applied per week per palm. But when drip irrigation is followed, irrigation is scheduled to compensate the loss of water through evapo transpiration which amounts to 40-50 litres per day for adult palms, under Kerala conditions.

Nutrient mixtures for the growth and productivity of coconut palms

Considering the soil and plant nutrient dynamics in the different coconut growing tracts of Kerala, ICAR-CPCRI, Regional Station, Kayamkulam has formulated different mixtures and conducted incubation as well as field studies on the release pattern and absorption by coconut plants. Based on the detailed experiments, two nutrient mixtures viz., 'Kalpa Poshak' and 'Kalpa Vardhini' have been developed for juvenile and adult coconut palms, respectively. Kalpa Poshak' comprises the nutrients such as potassium, boron, sulphur, zinc, copper whereas 'Kalpa Vardhini' contains potassium, magnesium, sulphur, boron and zinc in different concentrations. The dose recommended for 'Kalpa Poshak' is 40 g/ palm during first year after planting and 100 g/ palm for the second and third years of planting. The dose for 'Kalpa Vardhini' is 500g/ palm/year, which has to be applied in two splits. These mixtures are to be applied ten days after the application of normal recommended dose of fertilisers.

Conclusion

Being a perennial plantation crop, systematic adoption of appropriate nutrient management strategies can ensure the realization of the potential yield of the palm. Moreover replenishing the nutrients based on the palm requirement can restore the soil and palm health and thereby can sustain the palm productivity. Nutrient management also enriches the microbial activity and favors the soil biodiversity. Through the addition of palm residues, considerable amount of nutrients can be recycled back to the system, which is very essential to maintain the vitality of the system in a sustainable manner. These strategies may help in realizing higher yield which can help in achieving the ultimate objective of enhancing the farmers' income.

Reference

1. Coconut Cultivation Practices. 2007. ICAR- Central Plantation Crops Research Institute, Kasargod, Kerala. Eds. (Dhanapal, R., Thampan, C).Extension Publication No. 179. p.26. 2.http://www.agritech.tnau.ac.in/expert_system/coconut/coconut/coconut_mainfield. html) 3. Jeena Mathew, V. Krishnakumar V. Srinivasan, Ravi Bhat, Narayanan Namboothiri, Abdul Haris. 2018. Standardization of critical boron level in soil and leaves of coconut palms grown in a tropical Entisol. Journal of Soil Science and Plant Nutrition. 18 (2):376-387. ■

Fodder as Intercrop in Coconut Garden under Mixed Farming System

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Coconut is a major plantation crop of coastal India covering an area of 1.97 million ha which is predominantly cultivated in small and marginal holdings. Since coconut growers are more exposed to economic risks due to fluctuating market price, biotic- abiotic stresses, only systematic coconut based cropping/farming system makes it an economically viable crop in small holdings. Mixed farming is a profitable enterprise in such coconut plantations. Inclusion of cattle in coconut based cropping system is a practical option for enhancing the income of coconut farmers. The live stock component in the unit serves as a complimentary entity to the system. It provides adequate supply of organic matter to the system and nutritional security to the farm family. Maintenance of animals in sustainable way requires including fodder grass production in the system. Green fodder is an important source of

Mixed farming is a profitable enterprise in such coconut plantations. Inclusion of cattle in coconut based cropping system is a practical option for enhancing the income of coconut farmers. The live stock component in the unit serves as a complimentary entity to the system.

Trenches made at 60 cm for planting fodder slips

nutrition and roughage for dairy animals. The cost of fodder production can be reduced by substituting the nitrogen requirement through recycling of the organic wastes produced in the mixed farms.

Fodder grass in coconut plantations

India has one fourth of the world livestock population and the current fodder resources can meet only less than 50% of the requirement of livestock. Lack of cultivable land is one of the major constraints for increasing the area under fodder crops. Hybrid Bajra Napier can be profitably grown in the interspaces of coconut garden with 75% light intensity through nutrient recycling.It can be introduced as an intercrop in juvenile (0 to 3 years old) and old (more than 20 years) coconut plantations. Hybrid Bajra Napier (Pennisetum glaucum x P. purpureum) has wider acceptability among the farmers since it can be grown throughout the year under irrigated condition. The yield potential of green fodder is 150 to 200 t/ha with a crude protein of 9-12 %. The improved varieties are CO 3, CO 4, CO 5, PBN 233, APBN 1.

Planting

Rooted slips from the vegetative tillers can be used as planting material. The soil in the interspaces of coconut should be made to a fine tilth. For this the land needs to be ploughed well to a depth of 45cm and leveled. Fodder grass intercropping can be done in 150 cents (60 % area) of one hectare coconut plantation. Planting can be done immediately after the receipt of monsoon showers (May to June or September to October). It is better to avoid the planting during the dry periods of the year (February to April).

Grass slips are to be planted at a spacing of 60 cm in the trenches made at a distance of 2m from the basin of the palms. The trenches are to be made at 60cm apart and applied with basal dose of farm yard manure (25 t/ha) and inorganic fertilizers (90:30:24 kg NPK per ha of coconut plantation).

After cultivation practices

Fodder grass requires a moist ecosystem for proper establishment. For this, sprinkler irrigation facility can be provided in the system. At least two irrigations can be given within seven to ten days after planting for easy establishment of the crop. It requires subsequent irrigation depending upon rainfall and soil type. Irrigation with cowshed washing (once in 3 to 4 days interval) is a better option for robust growth and effective recycling of nutrients. The cowshed wash water can be collected in tanks (2.4 m x 2.4m) and utilized for irrigating the fodder grass for better water use efficiency. The newly emerging shoots from the slips needs to be protected from weeds for the first two months.

Harvesting and manuring

The first cut is usually done at 75 days after planting and subsequent cuttings are taken at 45 to 60 days interval. The harvesting interval is more during the winter season (December to February). Cutting is done at 15 to 20 cm from the ground level. After every harvest the fodder grass is supplied with nitrogenous fertilizers. For organic fodder production nutrients can be supplied through cowdung slurry (250 ml/clump) and vermicompost (125g/clump) in two equal splits ie; immediately after harvest and 15 days later. Application of Azospirillum (3.5 kg/ha/yr) along with the organics during June and September enhances the nutrient use efficiency. The farm wastes produced in the unit (approx. 14t/ha) can be effectively recycled to vermicompost using earthworms (Eudrillus sp) with around 60% recovery. This process helps in the recycling of the wastes in the system to organic nutrients.

Economics of cultivation

About six to seven harvests can be made in a year. Studies conducted at ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam reveals that this system of cultivation recorded a sustainable production of 126 t/ha/year of fodder grass in every year for a period of three years.

New Executive Councillors for Indian Society for Plantation Crops, ICAR-CPCRI

The Executive council of the ISPC for the year 2019- to 2020 is formed with Dr. H. P. Maheswarappa, Project Coordinator (Palms), AICRP on Palms, ICAR - CPCRI, Kasaragod as the President, Dr. B. Augustine Jerard, Head, Division of Horticulture and Forestry, ICAR-CIARI, Port Blair, A & N Island as Vice President, Dr. S. Jayasekhar, Senior Scientist, ICAR-CPCRI, Kasaragod, as Secretary and Dr. K. P. Chandran, Principal Scientist, ICAR-CPCRI, Kasaragod as the Treasurer. The executive councilors are: Dr. D. Ajay, Scientist C, Spices Board, Spices Park, Tamil Nadu; Dr. D Balasubramanian, Principal Scientist (AS & PE), ICAR-Directorate of Cashew Research, Puttur, Karnataka; Dr. Jeena Devasia, Plant Biotechnology Center, Coffee Board, Mysore; Dr. Samsudeen K, Principal Scientist, ICAR-CPCRI, Kasragod and Dr. P. Subramanian, Principal Scientist, ICAR-CPCRI,, Kasragod

General view of the experimental field

Replanting of fodder grass is recommended once in every three years. Considering the cost of fresh fodder as Rs.3/kg, a net return of Rs.2.5 lakh (cost benefit ratio of 1: 2.5) can be generated from the fodder as intercrop. With the available fodder, 10 to 12 milch cows can be introduced in to one hectare of coconut based farming system. This can generate a net income of Rs.4.5 lakhs per year (cost benefit ratio of 1: 1.7) to the farmer, apart from 10% average yield enhancement resulting in additional income from coconut. For small and marginal farmers inclusion of one or two milch cows into the system ensures nutritional security to the farm family. It also provides adequate organic matter for effective and sustainable nutrient recycling in the system.

Conclusion

Hybrid Bajra Napier can be grown as intercrop in coconut garden (60% area) with integrated nutrient management including basal dose of farm yard manure (25t/ha) and 90:30:24NPK through chemical fertilizers (urea, rock phosphate and Muriate of potash). Subsequent top dressing can be done after every harvest at 45 days interval (6 times a year) through the recycling of organic inputs such as cow dung slurry (3750 L ha-1), vermicompost (2000 kg ha-1) along with Azospirillum (3.5 kg ha-1) in two equal splits (immediately after harvest and 15 days later). This system of cultivation saves the usage of 50% inorganic fertilizers during the first year of planting and 100% in the succeeding years. The system can support 10 to 12 milch cows per hectare and generate a net return of Rs.4.5 lakh per year apart from additional benefit to coconut cultivation. ■

Management of Coconut Garden during Rainy Season

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Timely adoption of crop management practices especially soil health management and prophylactic/curative plant protection measures is very important to ensure sustainable coconut production. Diseases like bud rot and leaf rot affecting coconut are more prevalent during monsoon. Hence, timely adoption of prophylactic/curative measures is very important to avoid spread of these diseases during rainy season. Similarly, appropriate prophylactic/curative measures are to be adopted in rainy season for the effective management of pests like rhinoceros beetle, red palm weevil, root grubs and eriophyid mite to avoid crop loss in coconut.

Planting of coconut seedlings

In well drained soils, seedlings can be transplanted with the onset of southwest monsoon in the west coast region. If the land is uneven and full of shrubs, the shrubs have to be cleared and land levelled before taking pits. In laterite soil with rocky substratum, deeper and wider pits, 1.5 m x 1.5 m x 1.0 m may be dug and filled up with loose soil, powdered cow dung and ash up to a depth of 60 cm before planting. In loamy soils with low water table, planting in pit size of 1 m x 1 m x 1 m filled with top soil to height of 50 cm is generally recommended. However, when the water table is high, planting at the surface or even on mounds may be necessary. Two layers of coconut husk (with concave surface facing up) can be arranged at the bottom of the pit before filling up. This will help in conserving the moisture. In case of laterite soil, addition of 2 kg of common salt will help in loosening the soil.

For realizing better yield from coconut, optimum plant density must be maintained 'in the field. A spacing of 7.5 m x 7.5 m is generally recommended for coconut. This will accommodate 177 palms per ha under the square system of planting. If the triangular system is adopted, an additional 20 to 25 palms can be planted. Hedge system can also be adopted giving

a spacing of 5.0 to 5.5 m along the rows and 9 to 10 m between rows.

Generally underplanting is done in coconut gardens where the palms become unproductive and uneconomic to the farmer. Old palms are removed in stages over a period of 3 to 4 years. First peg mark the area to be underplanted. To start with underplanting, remove the very poor yielders (less than 10 nuts per palm per year) and those trees which are very close to the peg marked point for underplanting. Other trees are to be removed at the rate of one third each year during 2nd, 3rd and 4th year after starting underplanting. If the existing garden is irregularly spaced, remove old palms within 1 m radial distance from the newly planted seedlings in the first year of underplanting, 2 m distance in second year, 3 m distance in third year and the rest in 4th year.

Care of young palms

In areas subjected to water logging, care should be taken to provide drainage facility in the coconut garden during rainy season. The pits should be cleared of weeds periodically. Soil washed down and covering the collar of the seedlings during the rainy days should also be removed.

Green manuring

Cultivation of green manure legumes having symbiotic association with efficient Rhizobium strains in coconut basins and interspaces during the monsoon period is a simple agrotechnique that can be adopted to generate significant quantity of biomass which can be incorporated to the palms at their maximum vegetative growth. If it is homestead type of coconut farming with other inter/mixed crops in the interspace, basin management with green manure legumes can be adopted. Under monocropping, interspace can also be utilised for sowing green manure legumes. At the onset of monsoon, seeds of green manure legumes are to be sown @ 100 g per basin for basin management and the seed rate will be 25 kg per ha of coconut garden if interspace also can be utilised for generating green manure. Green manure leguminous species like cow pea, sunhemp, daincha, horse gram etc are suitable for this purpose. The field experiments on basin management with legumes in adult coconut plantations revealed the effectiveness of this technique to substitute fertilizer nitrogen for coconut upto 30 per cent.

Growing Glyricidia as green manure crop

Substantial quantity of nitrogen rich biomass can be produced through the cultivation of the fast growing perennial leguminous green leaf manure tree crop, Glyricidia in the coconut plantations. This can be very well grown along the borders of coconut plantation and can generate adequate amount of nitrogen rich green leaves. It can also be raised in littoral sandy soils where no other green manure can be established. The tree is propagated either through vegetative cuttings or seeds. One meter long stem cuttings or 3 to 4 month old seedlings raised in poly bags/raised beds can be used for planting. It is preferable that the planting season coincides with the monsoon (South West / North East monsoon) for better establishment. Spacing of 1 m x 1 m can be adopted. Two rows of glyricidia can be planted along the boundary of coconut garden in a zig zag manner. Plant stem cuttings or seedlings in an upright position in pits of 30 cm3. Height of the plants should always be maintained at 1 m by pruning.

Vermicomposting of coconut leaves

Rainy season is ideal for the production of vermicompost using coconut leaves. Fallen coconut leaves in coconut garden can be effectively converted into rich vermicompost using the earth worm, Eudrilus spp. Vermicompost preparation can be done in cement tanks or in trenches made in the coconut garden. The weathered coconut leaves collected from the garden should be kept for two weeks after sprinkling with cowdung slurry. Cowdung should be used at the rate of one tenth of the weight of the leaves. Afterwards earth worms (Eudrilus sp.) are to be introduced at the rate of one kg for one tonne of the material. Vermicompost will be ready in about 75 to 90 days.

Application of bio fertilizers

Application of phosphate solubilising

biofertilizers to coconut palms is highly beneficial when the available phosphorus content in the soil is low. CPCRI has released a product 'Keraprobio' which is a Plant Growth Promoting Rhizobacteria (PGPR) Bacillus megaterium which is also having the phosphate solubilising property. Kera probio can be applied @100 g/palm along with application of organic manures at the fag end of monsoon during August –September.

Fertilizer application

Soil related constraints, especially soil acidity and deficiency/imbalance of nutrients including major, secondary and micronutrients adversely affect coconut production. Hence, it is always advisable to test soil in the coconut garden periodically based on the results of which type and dosage of fertilizers and soil amendments should be decided. From an existing coconut garden soil sample should be taken from the basin of the palm 1 m away from the trunk. Under rainfed situation it is recommended to apply the chemical fertilizers in two splits. In the west coast region, apply one third quantity of recommended fertilizers as the first split after the receipt of summer showers during May and the remaining two-third quantity as second split dose during August-September after the cessation of heavy rains. First split dose ie one third of the recommended dose of fertilizers can be spread around the palms within a radius of 1.8 m in the coconut basin. For correcting soil acidity lime or dolomite can be applied. General recommendation is 1kg lime or dolomite per coconut tree which is to be applied two weeks before the application of chemical fertilizers.

Soil and water conservation measures

Proper soil and moisture conservation practices are essential for ensuring sustainable production especially when coconut is grown under rainfed condition with undulating terrain and sloppy conditions.

Husk burial

Burial of husk in trenches in between the rows of palms is also effective for moisture conservation in coconut gardens. Husk burial is to be done at the beginning of the monsoon in linear trenches of 1.5 to 2 m wide and about 0.3 to 0.5 m deep between rows of palms with concave side of husk facing upwards and each layer is to be covered with soil.

Mulching

Mulching is an important practice for moisture conservation. The coconut basins can be mulched with coir dust, coconut husks, green leaves, dried leaves, organic wastes, and dried coconut leaves. Mulching should be done before the end of north east monsoon and before the top soil dries up.

Catch pit filled with coconut husk

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

Contour trench filled with coconut husk

This measure is to be taken up where the land slope is high. Trenches of 50 cm width x 50 cm depth and convenient length are to be made in between two rows of coconut palms. These trenches would then be filled with coconut husk. Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down. A bund of 20 cm height and suitable width (>50 cm) is made at the downstream using the excavated soil. Two layers of pineapple plants are to be planted on the bund with a spacing of 20 cm x 20 cm. Pineapple plants would stabilize the bund and provide additional income to the farmer. The runoff water from the upper side would

be collected in the trenches. Soil particles would also get collected in the trench along with the runoff water. Coconut husk retains the moisture and makes it available for plants during summer months

Half-moon bund around coconut basin reinforced with pineapple

This measure is to be taken up where there is mild slope (15-20%). Here a flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the downstream side. After making the basin a bund of 30 cm height and >50 cm width is made at the downstream side of the coconut using the excavated soil. Two layers of pineapple plants would be planted with a spacing of 20 cm row to row and 20 cm plant to plant on the bund. The bund prevents runoff and water gets collected within the basin and percolates down. Pineapple would help to protect the bund and stabilize the same in addition to giving fruit yield.

Providing drainage

Proper drainage in the coconut garden is equally important as irrigation for better performance of coconut palms. Waterlogged conditions result in poor growth of palms. In ill drained garden, drainage facilities are to be provided during rainy season by digging deep and wide drains between the rows of palms and by raising the level of the ground around the individual palms.

Planting of perennials as mixed crops

Adoption of multiple cropping practices in coconut garden is suggested to ensure better utilization of basic resources and to enhance income and employment opportunities. After the palms attain a height of 5 to 6 metres (above 18 years) i.e., in older plantations, perennials like cocoa, pepper, cinnamon, clove and nutmeg can be grown as mixed crops. These crops can be planted at the onset of monsoon as per the details given below. These crops are to be adequately and separately manured in addition to the manures applied to the coconut palms. For facilitating multiple cropping in coconut gardens in the early growth phase itself it is advisable to have wider spacing of above 10 m x 10 m so as to provide ample opportunity to accommodate a number of perennial and annual crops in the interspaces.

Cultural requirements of crops for mixed cropping in coconut garden

Crops	Propa-gation	Planting pits	Spacing	No. of plants per ha
Cocoa	Grafts	75 x 75 x 75 cm	3m x 3m (Single hedge)	450
Pepper	Rooted cuttings	50 x 50 x 50 cm	7.5m x 7.5m (At the base of the palm)	175
Clove	Seed-lings	60 x 60 x 60 cm.	7.5m x 7.5m (At the centre of four palms)	148
Nutmeg	Grafts	60 x 60 x 60 cm	7.5m x 7.5m (Cen-tre of four palms)	148

Planting of suitable fodder grass species like Hybrid Bajra Napier (Co3) also can be taken up in coconut gardens at the onset of monsoon as part of coconut based mixed farming.

Field /crop sanitation measures

Decaying organic debris, dead coconut stumps, logs and other such organic materials from the coconut garden are to be removed as a measure of field sanitation to reduce incidence of pest/disease incidence before the monsoon sets in. Similarly, crown cleaning also has to be done before the rainy season.

Crop protection during rainy season

▶ *Disease management*

Diseases like bud rot and leaf rot affecting coconut are more prevalent during monsoon when the temperature is low and humidity is high. Hence, timely adoption of appropriate prophylactic/curative measures is very important to avoid spread of these diseases during rainy season.

▶ *Bud rot*

It is important to give prophylactic treatment to all palms in bud rot disease endemic areas at the onset of monsoon. In localities where bud rot is regularly observed crown cleaning of all palms should be taken up and 1% Bordeaux mixture sprayed as a prophylactic measure. Palms should be regularly observed and curative measures have to be adopted as and when the initial symptoms are seen. The earliest symptom is the yellowing of one or two younger leaves surrounding the spindle. The spindle withers and droops down. The tender leaf base and soft tissues of the crown rot into a slimy mass of decayed material emitting a foul smell. The disease kills the palm if not controlled at the early stages. In early stages of the disease, when the spindle leaf starts withering, cut and remove all affected tissues of

the crown and apply Bordeaux paste and protect it from rain by providing a polythene covering till normal shoot emerges. Burn all disease affected tissues removed from the palm. Field sanitation and providing adequate drainage in the coconut garden help to reduce the spread of the disease.

▶ *Leaf rot*

Leaf rot disease commonly occurs on coconut palms already affected by root (wilt) disease. Infection by this disease is the major reason for the low productivity of root (wilt) affected palms. As a prophylactic treatment against leaf rot disease mix 2 ml Hexaconazole 5 EC in 300 ml water and pour into the well around the base of the spindle leaf or apply talc based formulation of Pseudomonas fluorescens or Bacillus subtilis singly or in consortium @ 50 g in 500 ml/ palm at the onset of monsoon.

As the damage due to rhinoceros beetle infestation increases the chance of bud rot/leaf rot incidence, prophylactic leaf axil filling with 1:1 mixture of neem cake and sand @ 500g / palm before the onset of monsoon (May last week to June first week) is to be taken up on priority basis.

▶ *Pest management*

For the effective management of pests like rhinoceros beetle, red palm weevil, root grubs and eriophyid mite suitable prophylactic/curative measures are to be adopted in rainy season to avoid crop loss in coconut. Besides, close scrutiny and sustained monitoring in synergy with farm and palm hygiene is the key for success in pest suppression.

▶ *Rhinoceros beetle and red palm weevil*

For the management of rhinoceros beetle and red palm weevil infestation, prophylactic leaf axil filling with any of the following material before the onset of monsoon (May last week to June first week) is recommended.

- 1: 40 mixture of chloranthraniliprole granule (Fertera 0.4 % WG) and sand @ 250 g / palm (one round/year during May-June) or
- Leaf axil filling with 1:1 mixture of neem cake or marroti or pongamia and sand @ 500g / palm or
- Leaf axil filling with naphthalene ball @ 12 g / palm and placing sand above it. (Repeat at 45 days interval)

As curative treatment in red palm weevil infested palms, spot application with indoxacarb (Avaunt 15.8 EC) @ 2.5ml / litre or imidacloprid (Confidor 200 SL, 17.8 ai) @ 1 ml/ litre is found effective in suppressing the pest as well as recovery of palms.

▶ *Root grubs*

For the control of root grub infestation in coconut, blanket application of bifenthrin @ 2 kg ai/ ha (i.e., Talstar 10 EC @ 20 litre / ha) is to be adopted during the last-phase of the South-West monsoon ie., second week of August. Soil application of Steinernema carpocapsae @ 1.5 billion / ha during October is recommended for the bio-suppression of root grubs.

▶ *Coconut eriophyid mite*

In coconut palms with eriophyid mite incidence, spraying of neemazal (10000 ppm) @ 4 ml/ litre on young buttons after pollination or spraying of palm oil (20 %) sulphur (5%) emulsion during August is recommended.

Conclusion

Timely adoption of crop management practices especially soil health management and prophylactic/ curative plant protection measures is very important to ensure sustainable coconut production. Diseases like bud rot and leaf rot affecting coconut are more prevalent during monsoon. Hence, timely adoption of prophylactic/curative measures is very important to avoid spread of these diseases during rainy season. Similarly, appropriate prophylactic/curative measures are to be adopted in rainy season for the effective management of pests like rhinoceros beetle, red palm weevil, root grubs and eriophyid mite to avoid crop loss in coconut. Adoption of integrated disease management practices by few individual farmers alone can not control the incidence of the fungal disease. Hence, efforts are to be made to facilitate group action among the coconut farmers at grass root level to get desired results for the adoption of IDM practices against bud rot in coconut. Hence, Farmer Producer Organisations like Coconut Producer Societies, Federations and companies can play important role in organising coconut farmers for effectively adopting prophylactic/curative plant protection measures and other crop management practices during rainy season. ■

Enhancing Income of Coconut Growers through Effective Technology Integration - The need of the hour: V. Usha Rani IAS

'Enhancing income of coconut growers through effective technology integration is the need of the hour. Coconut growers who currently face difficulties due to price fluctuation of coconut in the market need to be supported for better utilisation of technologies to realise higher productivity and income.' Said Smt. V. Usha Rani IAS, Chairperson, Coconut Development Board. She was delivering the valedictory address of the Refresher Training Programme conducted for the officers of Coconut Development Board at ICAR-Central Plantation Crops Research Institute, Kasaragod. A substantial number of technologies have been developed by CPCRI and other research organisations for higher productivity and income from coconut farming which include improved varieties including hybrids, agro-techniques for nutrient management, water management and irrigation, multiple cropping and integrated farming, management of pests and diseases and value addition through product diversification. However, due to various factors coconut farmers are unable to effectively utilize the technologies and hence the extent of adoption of technologies is not at a satisfactory level in farmers' field. Hence, coconut farmers need to be supported for better technology integration in their coconut orchards. Farmer oriented technology transfer initiatives are needed since coconut in our country is predominantly a small holder's crop. Group approach is to be facilitated among the small and marginal coconut growers for achieving the economy of scale. It is also necessary to strengthen the functional linkages between research institutions, development and extension agencies and Farmer Producer Organisations and other stakeholders in coconut sector. Action plan will be formulated and implemented to better equip the Demonstration–cum-Seed Production Farms (DSP Farms) of CDB located in various parts of the country to demonstrate technologies developed by CPCRI for enhancing income from coconut farming. Scientific crop management technologies and small scale processing of coconut will be demonstrated in the DSP farms with the technical support from CPCRI. Steps will be taken to strengthen the coconut seedling production programme in DSP Farms.

Release of Training Manual

Certificate distribution


Field visit

More seedlings of coconut hybrid varieties will be produced by effectively utilising the mother palms available in the DSP farms and by following the hybridization technique recommended by CPCRI. Regular visit of scientists from CPCRI to DSP farms for recommendations on scientific crop management practices and pest and disease management to improve the functioning of farms will be ensured through appropriate memorandum of understanding. Smt. Usha Rani, IAS distributed certificates to the participants of the Refresher Training Programme. During the valedictory address Chairperson, CDB called upon the officers of CDB who are managing the DSP farms need to make more efforts to scientifically manage the farms so that coconut farmers and other stakeholders visiting the farms will be motivated to adopt the technologies demonstrated in the DSP farms in their coconut gardens. In a way, the DSP farms need to function as field units of research institutions like CPCRI showcasing relevant technologies pertaining to scientific coconut farming, she added. She also visited various experimental plots at CPCRI and held detailed discussion with the scientists about the progress of ongoing research projects at the Institute with the financial support of CDB and also about the thematic areas of coconut research for support from CDB in future. Chairperson, Coconut Development Board also released the Training Manual on 'Enhancing productivity in Coconut: Quality planting material and agro-techniques' in the valedictory function of refresher training programme. She appreciated the efforts of all Scientists of CPCRI for their hard work and dedication in research and extension in coconut sector. Refresher Training Programme on 'Hybridization Technique in Coconut'. A refresher training programme on 'Hybridization Technique in Coconut' for 20 selected officers of CDB was conducted at ICAR-CPCRI Kasaragod from 11th to 15th June 2019. The training programme was inaugurated by Dr. H. P. Maheswarappa, Project Coordinator, All India Co-ordinated Research Project on Palms. Dr. K. Muralidharan, Director-in Charge ICAR-CPCRI presided over the inaugural function. Dr. Thamban C., Principal Scientist and Co-ordinator of Refresher Training Programme welcomed the gathering, Dr. K.Samsudeen, Principal Scientist, presented the outline of the training programme and Ms. Ranjini T.N., Scientist proposed vote of thanks.


The participants

The five day training programme covered thematic areas pertaining to genetic resources and improved varieties of coconut, floral biology and hybridization technique in coconut, hybridization technique in coconut, concept and practice of participatory decentralised planting material production, nursery practices, agro-techniques for coconut and coconut based farming systems and integrated pest and disease management in coconut. Besides visit to CPCRI Research Centre, Kidu was conducted as part of the training programme to gain exposure on the maintenance of coconut genetic resources and commercial production of coconut hybrids. An

exclusive session for group discussion to formulate action plan for strengthening DSP farms to enhance planting material production was also included in the refresher training programme.

Smt. V. Usha Rani IAS, Chairperson, Coconut Development Board was the chief guest in the valedictory function of refresher training programme held on 15th June 2019. In her valedictory address Smt. Usha Rani IAS emphasised the need to better equip the Demonstration–cum-Seed Production Farms (DSP farms) under CDB located in various parts of the country to effectively demonstrate technologies developed by CPCRI for enhancing income from coconut farming. Chairperson, Coconut Development Board released the Training Manual on 'Enhancing productivity in coconut: Quality planting material and agro-techniques' in the valedictory function of refresher training programme and also distributed certificates to the participants.

Dr. K. Muralidharan, Director-in-Charge, ICAR-CPCRI presided over the valedictory function. Dr.

Thamban, C., Principal Scientist and Co-ordinator presented the report on the Refresher Training Programme and Dr. K.Samsudeen, Principal Scientist proposed vote of thanks.

(Report prepared by Dr. Thamban C., Principal Scientist (Agrl. Extension), ICAR-CPCRI, Kasaragod)
Photo courtesy: K. Syamaprasad ■

PAC of CDB approved 39 Projects of Rs. 930.863 lakh

Coconut Development Board (CDB) in its 53rd meeting of the Project Approval Committee (PAC) on Technology Mission on Coconut (TMOC) held at Kochi on 29th April 2019 under the Chairmanship of Smt. Usha Rani IAS Chairperson, CDB approved 39 projects with an outlay of Rs 930.863 lakhs. Out of the 39 projects approved, 26 projects are from NGOs, individual entrepreneurs and societies for setting up coconut based industries and 13 projects are from various research institutes from across India.

Dr. Wasakha Singh Dhillon, Assistant Director General (HS-II), Indian Council of Agriculture Research (ICAR), New Delhi; Dr. KSMS Raghav Rao, Director, CFTRI, Mysuru; Dr. M. Aravindakshan, Former Chairman, CDB; Mr. Sanjay Kumar, Deputy Commissioner (Hort), Krishi Bhavan, New Delhi, Smt Latha S., Deputy Secretary , Dept. of Agriculture, Governmant of Kerala; Mr. R. Srinivasan, Chief General Manager, NABARD, Trivandrum; Shri Philip Y. , Chief Manager, Indian Overseas Bank, Regional Office, Ernakulam, Kochi; Shri. PK Hameed Kutty, Deputy Agricultural Marketing Advisor, Directorate of Marketing and Inspection, Kochi; Shri Saradindu Das, Chief Coconut Development Officer, CDB, Kochi and Shri. R. Madhu, Secretary, CDB, Kochi attended the meeting.

Chairperson CDB visited DSP Farm of CDB & CPCRI Kahikuchi

Smt.V.Usha Rani IAS, Chairperson, CDB visited the DSP Farm of the Board at Abhayapuri, Assam and CPCRI Kahikuchi.

AGM of All India Co-ordinated Research Project

The 28th Annual Group Meeting of All India Co-ordianted Research Project on Palms was organized at Tamil Nadu Agricultural University, Coimbatore during 6th and 7th, June 2019. The inaugural function was presided over by Dr. N. Kumar, Vice Chancellor, Tamil Nadu Agricultural University, Dr. W.S. Dhillon, Assistant Director General (Horticultural Sciences), ICAR, New Delhi was the Chief Guest. Dr. P. Rethinam, Former Executive Director, Asian and Pacific Coconut Community, Jakarta, Dr.K.Muralidharan, Director, ICAR-CPCRI, Kasaragod and Dr.R.K.Mathur, Director,ICAR-IIOPR, Pedavegi were the guests of honour. Dr. K. S. Subramanian, Director of Research, TNAU, Coimbatore welcomed the gathering. The Project Co-ordinator of AICRP (Palms), Dr.H.P. Maheswarappa in his report briefed the mission and achievement of AICRP on five crops - coconut, oil palm, palmyrah, arecanut and cocoa distributed across 30 centres of 14 states and one union territory covering 13 State Agricultural Universities, four ICAR Institutes and two central universities.

Dr.W.S.Dhillon, Assistant Director General (HS -I), ICAR, New Delhi spoke on the overall growth of horticultural sector and its significant contribution to GDP and nutritional security of the nation. Dr. N. Kumar, Vice Chancellor, TNAU, in his presidential address underlined the need for the development of composite mother gardens for the production of quality seedlings and called on palm scientists to develop drought mitigation strategies considering the weather extremities. Fertigation strategies hold great promise in increasing palm productivity and invited palm researchers to take concerted efforts on developing hydraulic harvesters and value addition technologies. Dr.P.Rethinam, Former Director, Asian and Coconut Pacific Community, Jakarta highlighted the importance of IOT in agriculture and horticulture sectors and hinted the necessity of geotagging of oilpalm and tailoring irrigation in palms by employing water sensors. He appreciated Coconut Development Board for making farmers' clusters towards marketing of palm products. Dr. L. Pugalendhi, Dean (Hort.), TNAU, Coimbatore proposed the vote of thanks.

About 80 scientists from different AICRP centres and ICAR institutes participated in the meet. The inaugural session was followed by technical sessions on variety release proposal, genetic resources and crop improvement, crop production, crop protection and post harvest technology.

15 publications viz, books, technical bulletins, extension folders (in different languages) were released during the meeting. In the technical sessions, proposal for release of three oil palm tenera hybrids for different regions and one coconut variety was recommended. Region specific nutrient management in coconut based cropping system and protection technologies were recommended for transfer to extension agencies.

(Source : ICAR - AICRP on Palms, CPCRI, Kasaragod)

Coconut Development Board invites entries for National Awards

Coconut Development Board is inviting applications/ nominations for National Awards under various categories to recognize and promote excellence in coconut cultivation, innovative methods in coconut farming, product development, product improvement, quality improvement, product diversification and marketing, export and extension activities. The Awards are given for Coconut Farmer, Coconut Processor, Research Worker, Master Craftsman Manufacturing Coconut Based Handicrafts, Exporter of Coconut Products, Extension Worker in the Field of Coconut Development, Palm Climber, (Traditional, Friend of Coconut Tree and Neera Technician), Best Coconut Producer's Federation (CPF), Coconut Processing unit managed by women and the for the Best Demonstration cum Seed Production Farm of the Board. There are 23 awards under various sub categories.

The nomination/application for the Best coconut farmer awards (1. National Level, 2 South West Region- Big Farmer,3. South West Region- Small Farmer 4. East & North East Region- Big Farmer 5. East & North East Region- Small Farmer) has to be submitted to the Directors of Agriculture/Horticulture of the concerned state. The last date for receiving the applications for the farmer category recommended by the State Director of Agriculture/Horticulture/FPOs/Offices of CDB is 15th August 2019 and for all other categories are 30th July 2019. Details and application form of the award is available at the offices of the Board and also in the website of Coconut Development Board www.cococnutboard.nic.in

	Award Category & Cash Prize
1.	**The Best Coconut Farmer** **(i) National Level** - ***Rs. 50,000/-***
	(ii) South West (Kerala, Karnataka, Tamil Nadu, Pondicheri, Andhra Pradesh, Goa, Maharashtra, Gujarat,Daman&Diu,Andaman & Nicobar Islands and Lakshadweep) ***(a) Big farmers – having coconut cultivation above 1 ha - Rs. 25,000/-*** ***(b) Small farmers – having coconut cultivation upto 1 ha -Rs. 25,000/-***
	(iii) East & North East Region (all other states which are not grouped under the South West Region) ***(a) Big farmers – having coconut cultivation above 1 ha - Rs. 25,000/-*** ***(b) Small farmers – having coconut cultivation upto 1 ha - Rs. 25,000/-***
2.	**The Best Coconut Processor** ***(i) Food products/Non Food products - Rs. 50,000/-*** ***(ii) Non-conventional coconut products - Rs. 50,000/-***
3.	**The Best Coconut Research Worker** ***(i) Findings on coconut products - Rs. 50,000/-*** ***(ii) Machinery / Equipment Development - Rs. 50,000/-***
4.	**The Best Master Craftsman Manufacturing Coconut Based Handicrafts** ***(i) Master Craftsman (Large Scale Category) - Rs. 50,000/-*** ***(ii) Master Craftsman (Small Scale Category) - Rs.25,000/-***
5.	**The Best Exporter of Coconut Products** ***Category - Large Scale (Export turnover above Rs.10 crore/year) - Rs.50,000/-*** ***Category - Small Scale (Export turnover upto Rs.10 crore/year) - Rs.25,000/-***
6.	**The Best Coconut Extension Personnel in Coconut Development** - ***Rs.50,000/-***
7.	**The Best Co-operative Society / NGO in Coconut Development** - ***Rs.50,000/-***
8.	**The Best Palm Climber** ***(i) Climber using traditional methods- Male - Rs. 25,000/-*** ***(ii) Climber using traditional methods- Female - Rs. 25,000/-*** ***(iii) Coconut climbers under FoCT scheme of CDB - Male - Rs. 25,000/-*** ***(iv) Coconut climbers under FoCT scheme of CDB - Female - Rs. 25,000/-*** ***(v) The Best Neera Technician –All India -Rs. 25,000/-***
9.	**The Best Coconut Producer's Federation** - ***Rs. 50,000/-***
10.	**The Best Coconut Processing Unit Managed by Women** - ***Rs. 25,000/-***
11.	**The Best DSP Farm of CDB** - ***Rs. 5,00,000/-***

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

Adult weevils

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.

▶ *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 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.

Pest-infested field

Black headed caterpillar Goniozus nephantidis

▶ *Management*

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

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

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

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

P.bondari

P. minei

Cybocephalus sp.

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 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

Leaf rot disease affected palm leaflets

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.

Withering of spear leaf

▶ *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. ■

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

Market Review – May 2019

Domestic Price

Coconut Oil

During May 2019 the price of coconut oil opened at Rs.15900 per quintal at Kochi and Alappuzha market and Rs.16200 per quintal at Kozhikode market. During the month, price of coconut oil at all three markets expressed an overall downward trend.

The price of coconut oil closed at Rs.14400 per quintal at Kochi and Alappuzha market and Rs.15050 per quintal at Kozhikode market with a net loss of Rs.1500 per quintal at Kochi and Alappuzha market and Rs.1150 per quintal at Kozhikode market.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.12333 per quintal, expressed an overall downward trend during the month and closed at Rs.11533 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
01.05.2019	15900	15900	16200	12333
05.05.2019	15600	15700	16200	12333
12.05.2019	15300	15300	15900	12000
19.05.2019	14700	14700	15200	11667
26.05.2019	14700	14700	15200	11867
31.05.2019	14400	14400	15050	11533

Milling copra

During the month, the price of milling copra opened at Rs.9900 per quintal at Kochi, Rs.9800 per quintal at Alappuzha and Rs.10050 per quintal at Kozhikode market. The price of milling copra at all three markets expressed an overall downward trend during the month.

The prices closed at Rs.8900 at Kochi market, Rs.8800 at Alappuzha and Rs.9150 at Kozhikode markets with a net loss of Rs.1000 per quintal at Kochi and Alappuzha market and Rs.900 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices opened at Rs. 8800 per quintal and closed at Rs.8000 per quintal with a net loss of Rs.800 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.05.2019	9900	9800	10050	8800
05.05.2019	9600	9600	10000	8600
12.05.2019	9300	9200	9700	8500
19.05.2019	9050	8950	9300	8300
26.05.2019	9050	8950	9300	8400
31.05.2019	8900	8800	9150	8000

Edible copra

The price of Rajapur copra at Kozhikode market opened at Rs. 16500 per quintal expressed a mixed trend during the month and closed at Rs.15100 per quintal with a net loss of Rs.1400 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.05.2019	16500
05.05.2019	16200
12.05.2019	16100
19.05.2019	14700
26.05.2019	15600
31.05.2019	15100

Ball copra

The price of ball copra at Tiptur market which opened at Rs.16500 per quintal expressed an overall downward trend during the month and closed at Rs.15000 per quintal with a net loss of Rs.1500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
01.05.2019	16500
05.05.2019	16000
12.05.2019	15700
19.05.2019	15500
26.05.2019	15000
31.05.2019	15000

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.7000 per quintal expressed an overall mixed trend during the month. The prices closed at Rs.10100 per quintal with a net gain of Rs.3100 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.05.2019	7000
05.05.2019	7500
12.05.2019	10900
19.05.2019	10400
26.05.2019	10200
31.05.2019	10100

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.14000 per thousand nuts and closed at Rs.12000 per thousand nuts during the month. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.11500 per thousand nuts and closed at Rs.10000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs. 18500 and closed at Rs.17000 per thousand nuts.

Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Pollachi	Banglore
01.05.2019	14000	11500	18500
05.05.2019	14000	10000	18500
12.05.2019	14000	10000	17500
19.05.2019	14000	10000	17500
26.05.2019	14000	10000	17000
31.05.2019	12000	10000	17000

International price

Coconut oil

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

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/ MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri lanka	India*
04.05.2019	652	620	624	1819	1767
11.05.2019	670	615	642	1845	1719
18.05.2019	679	n.q.	648	1787	1672
25.05.2019	661	649	646	1755	1700
04.05.2019	652	620	624	1819	1767
					* Kangayam

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.05.2019	422	385	937	1232
11.05.2019	414	387	1024	1218
18.05.2019	405	401	1023	1189
25.05.2019	405	398	1021	1204
04.05.2019	422	385	937	1232
				* Kangayam

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.05.2019	115	146	156	358
11.05.2019	114	146	123	322
18.05.2019	112	146	116	308
25.05.2019	112	146	140	322
				*Pollachi market