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Message from the Chairperson's Desk

Dear readers,

Hearty Greetings from Coconut Development Board !

Coconut Development Board with the objective of the integrated development of coconut farming and industry in the country, has already taken up the preliminary initiatives for the implementation of its Annual Action Plan for the current financial year. The recently held joint meeting of the State Governments and the Board on implementation of CDB schemes with the annual allocation of Rs. 211.90 crore by the Ministry of Agriculture and Farmers Welfare, Govt. of India was the first step in this regard.

CDB is giving highest priority for bringing in more area under coconut cultivation as the demand for coconut products both in the domestic as well as international markets are on the rise. The target under area expansion for the year 2019-20 has been increased to around 25,000 ha. focusing on nontraditional coconut growing belts. There is a quantum jump of four to five fold increase compared to the previous year in the expansion of area under coconut.

Coconut being a perennial crop with a long duration, quality planting material is to be ensured for profitability in the sector. The current seedling production level of 35 lakh seedlings is much low compared to the projected demand of 100 lakh seedlings. Hence CDB has substantially increased its allocation for production of seedlings by government and private sector to more than Rs. 10 crore during 2019-20. The present level of value addition in coconut sector in the country is very meager compared to the other coconut producing countries. Considering the huge scope for value addition in the country, which will benefit the farmers for sustainable income, an amount of Rs. 40 crore is allocated for the scheme Technology Mission on Coconut during 2019-20.

Awareness programmes are planned to move forward both in cultivation as well as processing and marketing oriented activities among the prosperous target groups and to extend the benefits of the government schemes to the beneficiaries. To increase the penetration of the schemes of the Board to the grass root level farmers, the three pronged approach is planned with orientation of the state government officials to start with, followed by the empowering of FPOs and finally the progressive coconut farmers. CDB is proposing to conduct workshops, seminars, campaigns etc. at state, district and block level for the farmers and rural entrepreneurs across the country.

From this year onwards CDB will utilize the Direct Benefit Transfer (DBT) mode for extending the government benefits to the eligible beneficiaries. The benefits directly extended by the Board will be in PFMS platform of the Govt. of India.

Looking forward for the cooperation of one and all.

V Usha Rani IAS
Chairperson

Genetic resource management and improved varieties of coconut

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Introduction

The coconut palm, *Cocos nucifera L.*, is a multi-purpose palm grown widely in the humid tropics and in India it is referred to as 'Kalpavrisksha' considering that it provides all necessities of life. Coconut provides nutritious food and refreshing drink, oil for edible and non-edible uses, fibre of commercial value, shell for fuel and industrial uses, timber and a variety of miscellaneous products for use as domestic fuel. About 10 million families depend on coconut for their livelihood and as an important oil crop in the country, it contributes about 7.8 per cent to the national vegetable oil pool. In recent years, coconut is being increasingly considered as a health food, with virgin coconut oil, tender coconut water and inflorescence sap (neera) being promoted for consumption.

The average national productivity of coconut in India is around 64 nuts per palm per year. In contrast, certain elite coconut palms are reported to yield >400 coconuts per palm per year. With a focus to improve

The average national productivity of coconut in India is around 64 nuts per palm per year. Certain elite coconut palms are reported to yield more than 400 coconuts per palm per year. With a focus to improve productivity and overall profitability to the farmers, research efforts have been focused on development of high yielding coconut varieties.

Coconut palms are broadly classified into the talls and the dwarfs. Tall palms are the most commonly cultivated in all coconut growing regions of the world. Dwarf palms are not grown on a commercial scale. They are of shorter stature, 8-10 m high when 20 years old and start bearing about 3-4 years after planting

productivity and overall profitability to the farmers, research efforts have been focused on development of high yielding coconut varieties.

Diversity in coconut forms

The coconut palm, *Cocos nucifera L.,* a monotypic species under the genus Cocos, exhibits a lot of variability in forms with several distinct populations and ecotypes, widely differing from each other in morphological characters, particularly with respect to fruit characters and plant habit.

Plant habit

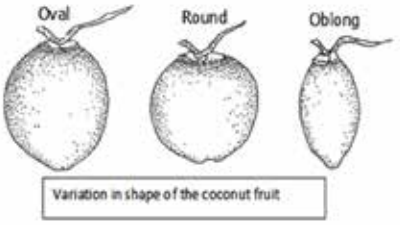
Coconut palms are broadly classified into two groups based on plant habit viz., the talls and the dwarfs. Tall palms, also referred to as var. typica, and are the most commonly cultivated in all coconut growing regions of the world. Tall palms grow to a height of 20-30 m, have a sturdy stem, commence flowering 6-10 years after planting and continue bearing up to the age of 80-100 years. Tall palms are normally cross-pollinated and hence highly heterozygous. The fruits are generally medium to large in size and produce good quantity and quality of copra with fairly high oil content. Among the indigenous tall cultivars, West Coast Tall (WCT), East Coast Tall (ECT), Benaulim Tall (BENT), Tiptur Tall (TPT), Andaman Ordinary Tall (ADOT) and Laccadive Ordinary Tall (LCT) are popular. Some popular exotic tall cultivars are Fiji Tall (FJT), Philippines Ordinary Tall (PHOT), Sri Lankan Tall (SLT), West African Tall (WAT), Panama Tall (PNT), Malayan Tall (MLT), Jamaican Tall (JAMT) and San Ramon Tall (SNRT).

Dwarf palms are referred to as var. nana. They are not grown on a commercial scale. They are of shorter stature, 8-10 m high when 20 years old and start bearing about 3-4 years after planting and have a short productive life of about 40-50 years. The dwarf palms are more homozygous than talls, due to a high degree of self-pollination. They produce fruits, which are generally small to medium in size. The dwarfs are presumed to have originated from talls either through mutation or by inbreeding. The popular dwarf cultivars grown in India are Chowghat Green Dwarf (CGD), Chowghat Orange Dwarf (COD), Kenthali Orange Dwarf (KTOD) and Gangabondam Green Dwarf (GBGD). Among the exotic dwarf cultivars, Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD) and Malayan Green Dwarf (MGD) have become popular in all coconut-growing countries of the world.

The tall and dwarf types have been utilized for development of hybrid varieties, combining the early flowering trait of dwarfs with the hardiness and high yielding character of tall parents and also exploitation of hybrid vigour.

Fruit characters

Considerable diversity is observed in the size, shape and colour of fruits of coconut palm. The colour of the fruit varies from yellow, shades of green and brown to red (orange). The variations in shapes of the coconut fruit are broadly classified as round, oblong or elliptic. Further, based on the equatorial view, the shape of coconut fruits can be classified as angled, round or flat based on the curvature of the fruit and the presence of ridges on the fruit. Variations are recorded in shape of the nut inside the fruit and these are broadly categorized as round, oval and oblong.



Variation in shape of the coconut fruit

Coconut genetic resources

CPCRI, being the premier national institute undertaking coconut research, maintains the world's largest repository of coconut germplasm and is designated by the National Bureau of Plant Genetic Resources (NBPGR) as the National Active Germplasm

Site for coconut in the country. Over the years, CPCRI has collected, for conservation and characterization, about 455 coconut accessions, including 132 exotic and 323 indigenous collections. In addition, CPCRI also hosts the International Coconut Gene Bank for South Asia at CPCRI Research Centre Kidu in Karnataka under a tripartite agreement among ICAR-FAO-ITPGRFA, besides the National Coconut Gene Bank (NCGB).

The large collection of coconut germplasm maintained at CPCRI is being characterized and evaluated for agronomic characters, yield and performance at the institute. Promising accessions are then evaluated for their performance and regional adaptability at the 15 centers under the All India Coordinated Project on Palms, located in nine State Agricultural Universities, one Central Agricultural University and two research institutes.

Crop improvement research, through evaluation and utilization of coconut genetic resources in the country, has resulted in the development of several improved varieties, through mass selection and hybridization approaches and the improved varieties and hybrids are capable of producing 1.63 to 6.2 tonnes of copra/ha/year. So far, 20 coconut hybrid varieties and 29 selections have been developed and released for commercial cultivation in different agroclimatic zones and states of the country. Breeding efforts in the country in addition to development of high yielding varieties suitable for copra/oil/tender nut have also focused on development of disease resistance, especially to root (wilt) disease, moisture stress tolerance and varieties for ornamental purpose.

Varieties evolved through selection

Selection and evaluation of promising accessions conserved both at the institute, the coordinating centers under the All India Coordinated Research Project on Palms and State Agricultural Universities have resulted in the development and release of 29 high yielding varieties of coconut, suitable for different agro climatic zones, through application of mass selection. Table 1 indicates the varieties suitable for cultivation in the different states of the country.

Exploitation of hybrid vigour

In India, heterosis breeding has been employed for development of hybrid coconut varieties through hybridization between indigenous and exotic

selections of Talls and Dwarfs. The first coconut hybrid in the country was produced at the erstwhile Coconut Research Station, in 1934 by Dr. J.S. Patel using West Coast Tall as female parent and Chowghat Green Dwarf as male parent. The resultant hybrid progeny exhibited seedling vigour in the nursery, resulting in the first documented report in the world of hybrid vigour/heterosis in coconut by Patel in the year 1937. Subsequently, these hybrids manifested earliness in flowering, increased nut yield, higher copra yield with better quality of copra and oil compared to the parents. In the immediate years after the discovery of hybrid vigour in WCT x CGD hybrids, the emphasis was on development and evaluation of Tall x Dwarf (T x D) hybrids. Subsequently, Dwarf x Tall (D x T) hybrids were also produced and evaluated, considering the occurrence in the nursery of naturally crossed dwarfs (NCD) in open pollinated progenies of dwarf palms. Much later, Tall x Tall (T x T) and Dwarf x Dwarf (D x D) inter-varietal hybrids were also produced at the Institute for evaluation of the hybrid progenies for yield and other desirable traits. Till date, more than 100 cross combinations have been developed for evaluation of yield potential at CPCRI, SAUs and the centres under the AICRP on Palms. So far, 20 hybrids, including seven superior Dwarf x Tall hybrid varieties and 13 Tall x Dwarf hybrid varieties have been developed for commercial cultivation in different parts of the country (Table 2). These hybrids are capable of producing 2.79 to 6.2 tonnes of copra/ha/year.

Breeding for drought tolerance

Drought is one of the major limiting factors that considerably reduce nut production. However, severity of drought and response of palms to

Table 1. Improved coconut varieties developed through selection				
Variety	**Important traits**	**Nut yield (ha-1 year-1)**	**Copra yield (t ha-1 year-1)**	**Recommended states/regions**
Tall				
Chandra Kalpa	Drought tolerant, high copra, oil content	17700	3.12	Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra
Kera Chandra	High yield, dual purpose variety for copra and tender nut	19470	3.86	Kerala, Karnataka, Konkan region, Andhra Pradesh, West Bengal
Kalpa Pratibha	High nut, oil yield, dual purpose variety for copra and tender nut	16107	4.12	Kerala, Andhra Pradesh, Tamil Nadu, Maharashtra
Kalpa Mitra	High nut, oil yield, drought tolerant	15222	3.68	Kerala, West Bengal
Kalpa Dhenu	High nut, oil yield, drought tolerant	14160	3.41	Kerala, Tamil Nadu, Andaman & Nicobar Islands
Kalparaksha	Semi-tall, high nut and oil yield in RWD prevalent areas; tender nut purpose	13260 (17748)#	2.85 (3.34)	Kerala, Root (wilt) disease prevalent tracts
Kalpa Haritha	Dual purpose variety for copra and tender nut; less eriophyid mite damage	20886	3.70	Kerala, Karnataka
Kalpatharu	Drought tolerant, ball copra, high yield	20709	3.64	Kerala, Karnataka, Tamil Nadu
Pratap	High yield	26727	4.01	Maharashtra
Kamarupa	High yield	17877	2.90	Assam
ALR (CN) 1	High yield	22302	3.50	Tamil Nadu
Kera Bastar	High yield	19470	3.18	Chhattisgarh, Maharashtra, Tamil Nadu, Andhra Pradesh
Kalyani Coconut	High yield	14160	3.84	West Bengal
Kera Keralam	High yield	26019	3.53	Tamil Nadu, Karnataka, Kerala
ALR (CN) 2	High yield	21240	2.89	Tamil Nadu
VPM-3	High yield, drought tolerant	14868	3.41	Tamil Nadu
Kera Sagara	High yield	17523	3.64	Kerala
Kera Madhura	Semi-tall, dual purpose variety for copra and tender nut	24480	4.80	Kerala
Double century	High yield	23140	4.60	Andhra Pradesh
Kalpa Shatabdi	Tall, dual purpose variety for copra and tender nut	18375	5.01	Kerala, Karnataka, Tamil Nadu
Dwarf				
Chowghat Orange Dwarf	Tender nut purpose, orange colour fruit	22848	3.20	All coconut growing regions for tender nut
Gouthami Ganga	Tender nut purpose, green colour fruit	13260	2.08	Andhra Pradesh
Kalpasree	Early flowering, green colour fruit superior oil, recommended for root (wilt) diseased areas	18360	1.77	Root (wilt) disease prevalent tracts
Kalpa Jyothi	Tender nut purpose, yellow colour fruit	23256	3.30	Kerala, Karnataka, Assam
Kalpa Surya	Tender nut purpose, orange colour fruit	25092	4.69	Kerala, Karnataka, Tamil Nadu
CARI-C1 (Annapurna)	High copra content, tender nut purpose, green colour fruit	10526	2.53	Andaman & Nicobar Islands
CARI-C2 (Surya)	Ornamental purpose, orange colour fruit	23317	1.63	Andaman & Nicobar Islands
CARI-C3 (Omkar)	Ornamental purpose, yellow colour fruit	27744	2.04	Andaman & Nicobar Islands
CARI-C4 (Chandan)	Ornamental purpose, orange colour fruit	18870	1.92	Andaman & Nicobar Islands
#- Figures in parenthesis indicate yield in root (wilt) disease free tracts				

Table 2. Coconut hybrids released for commercial cultivation in India

Hybrid Variety	Source population of parents	Important traits	Nut yield (ha-1 year-1)	Copra yield (t ha-1 year-1)	Area recommended
Chandra Sankara	COD x WCT	High yield	20532	4.27	Kerala, Karnataka, Tamil Nadu
Kera Sankara	WCT x COD	High yield, drought tolerant	19116	3.78	Kerala, Karnataka, Maharashtra, Andhra Pradesh
Chandra Laksha	LCT x COD	High yield, drought tolerant	19293	3.76	Kerala, Karnataka
Kalpa Samrudhi	MYD x WCT	Dual purpose variety, Drought tolerant, higher nutrient use efficiency	20744	4.35	Kerala, Assam
Kalpa Sankara	CGD x WCT	Tolerant to root (wilt) disease, high yield	14868	3.20	Root (wilt) disease prevalent tracts
Laksha Ganga	LCT x GBGD	High yield	19116	3.73	Kerala
Ananda Ganga	ADOT x GBGD	High yield	16815	3.63	Kerala
Kera Ganga	WCT x GBGD	High yield	17700	3.56	Kerala
Kera Sree	WCT x MYD	High yield	23364	5.05	Kerala
Kera Sowbhagya	WCT x SSAT	High yield	23010	4.49	Kerala
VHC-1	ECT x MGD	High yield	21240	2.87	Tamil Nadu
VHC-2	ECT x MYD	High yield	25134	3.74	Tamil Nadu
VHC-3	ECT x MOD	High yield	27612	4.47	Tamil Nadu
Godavari Ganga	ECT x GBGD	High yield	18585	2.79	Andhra Pradesh
Konkan Bhatye coconut hybrid 1	GBGD x ECT	High yield	20532	3.47	Maharashtra
Kalpa Ganga	GBGD x FJT	High yield, suitable for ball copra production	21417	3.38	Karnataka
Vasista Ganga	GBGD x PHOT	High yield	22125	3.88	Andhra Pradesh, Karnataka
VPM-5	LCT x CCNT	High yield	28497	4.22	Tamil Nadu
Kalpa Sreshta	MYD x TPT	High yield, Dual purpose for copra and tender nut	29227	6.28	Kerala, Karnataka

drought are location specific. Therefore, once physiological traits are identified, selection of most appropriate cultivars for a given environment is possible. Laccadive Ordinary was found to be relatively more tolerant to drought than other cultivars. The hybrids LCT x COD and LCT x GBGD were also found to give higher yields under drought conditions.

CPCRI has identified certain drought tolerant cultivars like Federated Malay States, Java Giant, Fiji and Andaman Giant. All these identified drought tolerant cultivars are being used in the breeding programme at CPCRI, Kasaragod to identify high yielding hybrids possessing drought tolerance.

Breeding for disease resistance

Coconut root (wilt) disease is the most serious problem causing an annual loss of 968 million nuts in the eight southern districts of Kerala and now spreading to the neighboring districts of Kerala and Tamil Nadu. As no effective control measures are available for this disease, developing resistant/tolerant genotypes and the identification of sources of resistance is of utmost importance. Recent findings revealed that cultivars CGD and MGD showed higher level of resistance than other cultivars. Hence, a survey for the identification of disease–free palms in 'hot spot' areas (heavily diseased tracts) has been undertaken and 'disease free palms' were selected based on the serological and physiological tests. Also, some disease free CGD and COD palms were identified in 'hot spot' areas. These palms are being utilized

in the breeding programme for the production of tolerant/resistant hybrids. Among the different combinations identified, CGD x WCT was found to be tolerant to root (wilt) disease and steps have been taken to produce these hybrids on a large scale for planting in disease endemic areas, to screen them for field tolerance to root (wilt) disease, in the 'hot spot' districts of Alappuzha, Kollam, Pathanamthitta and Kottayam. Nucleus seed gardens have been established with the progenies of these identified tolerant / resistant palms for meeting the future planting material needs and crop improvement for root (wilt) resistance.

Description of coconut varieties released from ICAR- CPCRI

The practical identification of varieties is very important for the growers, extension functionaries, and nursery men as well as for the research workers. To familiarize the stakeholders with the coconut varieties developed at the Institute, a brief account of the characteristic features of the varieties developed by the Institute and recommended for commercial cultivation are described below.

Among the 14 selections released by CPCRI for commercial cultivation, Chowghat Orange Dwarf, Kalpa Surya and Kalpa Jyothi are released as exclusive tender nut varieties. Kalparaksha and Kalpasree are recommended for root (wilt) affected tracts, as disease tolerant varieties. Kalpa Pratibha, Kera Chandra, Kalpa Haritha, Kalparaksha and Kalpa Shatabdi are recommended as a dual purpose varieties suited for both copra and tender nut purpose. Kalpatharu is recommended as a ball copra variety, owing to minimal spoilage and higher recovery percentage of ball copra. The varieties, Chandra Kalpa, Kalpa Mitra, Kalpa Dhenu and Kalpatharu are also relatively tolerant to drought.

Dwarf varieties

Chowghat Orange Dwarf

Chowghat Orange Dwarf is recommended as a tender nut variety for cultivation in the country. It is a selection from the indigenous orange dwarf IND 007 found sparsely cultivated throughout the west coast region of India, particularly in the Chavakkad area of Thrissur district of Kerala. The palm has a thin stem with closely arranged leaf scars, a small compact crown with characteristic orange colour on leaf petioles, inflorescences and fruits. This is an early flowering cultivar and takes about 3-4 years for initial flowering. This is largely a self-pollinating cultivar. The palms of this variety are sensitive to moisture stress and also show alternate bearing habit. Under irrigated and well maintained gardens, higher average annual yield of 112 nuts/palm can be realized.

The fruits are small with an average weight of 634 gm and average copra content of 128 gm/nut and 66 % oil. The variety Chowghat Orange Dwarf was found to have the highest total sugar content in the tender nut water on comparative evaluation of tender nut water quality in 44 accessions at CPCRI, Kasargod and hence was developed by CPCRI as a tender nut variety. The tender nut water of 7 month old fruit is sweet with a total sugar content of 7.0 gm/100 ml and sodium and potassium contents of 20 ppm and 2000 ppm, respectively and organoleptically graded as 'very good'. The variety Chowghat Orange Dwarf was recommended by the X Biennial Workshop of the All India Coordinated Research Project on Palms in 1991 as a tender nut variety for cultivation in the country.

Further, this variety also serves as parental palm for production of Kera Sankara (WCT x COD) and Chandra Sankara (COD x WCT) hybrid varieties of coconut. Hence, COD has been planted in isolated blocks in the seed gardens in Kerala, Karnataka and Tamil Nadu for the production of seed nuts of Dwarf x Tall (Chandra Sankara) as well as Tall x Dwarf (Kera Sankara) hybrid varieties. This variety also has potential in landscaping as an ornamental coconut palm.

Kalpasree

Kalpasree variety of coconut, is developed by the Central Plantation Crops Research Institute, Regional Station, Kayamkulam, as a superior, root (wilt) disease resistant variety with high yield potential for cultivation in homesteads in root (wilt) prevalent tracts, by selection from the indigenous dwarf cultivar, Chowghat Green Dwarf. The variety is early flowering and takes about 2.5 to 3 years for flowering. The leaf petioles, leaves and nuts are dark green in colour. The fruits are oblong in shape and have a characteristic 'beak' when fully mature. Kalpasree has superior quality of coconut oil, very sweet tender nut water and meat and is resistant to root (wilt) disease. The palm attains a height of around 4 m at 20 years of age. It can be grown for tender nut purpose as it contains nut water of 240 ml and is very sweet in taste. The nutritive value of tender nut water is as follows: total sugars-4.80 g/ml, potassium content -2150 ppm, sodium content

- 22.40 ppm. The data on fatty acid profile of the coconut oil from this variety, reveals that Kalpasree is rich is long chain unsaturated fatty acids (LUSFA's) and is healthier compared to oil of WCT and COD. Coconut oil of Kalpasree also has 25% to 40% more essential fatty acids during all seasons compared to oil from WCT and COD, respectively. Besides, Kalpasree oil is rich in essential fatty acids especially linoleic acid. However, the variety is more sensitive to biotic stress and caution is advised to adopt plant protection measures against major pests particularly red palm weevil, when large scale commercial plantings are adopted.

The recommendation is based on the superior performance of Kalpasree at CPCRI, Regional Station, Kayamkulam and in various farmers plots located in 'hotspots' of root (wilt) disease. The variety was recommended for release by XIX Biennial Workshop of the All India Coordinated Research Project on Palms in the year 2009 and released and notified for cultivation in the root (wilt) affected tracts of the country by the Central Sub-committee on Crop Standards, Notification and Release vide Notification of Ministry of Agriculture (Department of Agriculture and Co-operation) S.O. 456(E) dated March 16, 2012.

Kalpa Jyothi

Kalpa Jyothi variety is derived from the CPCRI accession IND 058, an introduction from Malaysia, acquired in 1961. The population was developed at CPCRI through selection of superior high yielding palms and inter se mating between the selected palms. This variety was evaluated and found to perform well with high yielding dwarf variety at CPCRI, Kasaragod and CPCRI Research Centre Kidu and also at the AICRP on Palm centres in Karnataka and Assam. Kalpa Jyothi variety gives higher yield of 114 nuts per palm per year over the local control (COD) in terms of annual nut yield as well as copra yield/palm. The estimated nut and copra yield per hectare was 114% and 123% higher than COD under rainfed conditions at Kasaragod. The variety is recommended for cultivation in the coconut growing tracts of Kerala, Karnataka, Assam states as a dwarf variety. The recommendation is based on the superior performance of the variety at CPCRI, Kasargod in Coastal Kerala, CPCRI, Research Centre, Kidu and AICRP On Palms centres at HRS, Arsikere in Karnataka and HRS, Kahikuchi in Assam.

The palms of this variety are relatively dwarf in habit with a compact spherical canopy. The fruits are medium, round in shape and yellow in colour. The

quantity of tender nut water is around 380 ml and good in taste with TSS of 5.9. The nutritive value of tender nut water: total sugars – 6.2 g/100ml, free amino acids -1.7 mg/100ml, sodium – 36 ppm, potassium – 1998 ppm. The average fruit weight of Kalpa Jyothi variety is 649 g, with copra content of 142.42 g/nut, with copra oil content of 61.5%. The palms are regular bearers and commence flowering 38 months after planting in the field. However, the average time taken for flowering in 50% of the palms in the population is 51 months. No major disease outbreaks were observed under field conditions. However, the palms of this variety are moderately susceptible to bud rot. No major pest attacks observed under field conditions. However, the palms of this variety are attacked by rhinoceros beetle as well as red palm weevil. It is also moderately affected by eripohyid mite. Dwarf varieties in general are classified as drought susceptible and recommended for large scale cultivation only under irrigated conditions. However, among the dwarfs evaluated, this variety exhibits better tolerance to water stress conditions.

The variety Kalpa Jyothi has distinguishing characteristics of yellow petiole colour, yellow fruit colour, thin fruit shell thickness, low fruit weight, and very low shell weight. Kalpa Jyothi is stable for most

of the grouping traits. However, about 5% variability is expected due to inherent heterozygosity of the crop and hence seedling selection is to be followed.

Considering the superiority of this dwarf variety for nut yield, coupled with tender nut water quality, the XXI Biennial Workshop of the All India Coordinated Research Project on Palms during the year 2012 recommended that this variety may be released as a dwarf tender nut variety for commercial cultivation.

This variety is a high yielding dwarf variety and will contribute to enhancing coconut productivity in the country. It has the potential to yield 29947 nuts per ha of coconut garden and this can be harnessed to tap the tender nut water requirement. Further, the yellow colour of the fruits is also aesthetically very attractive and hence this variety can also be used for avenue planting with adequate precaution to prevent falling of dry fruits/leaves on pedestrians.

Kalpa Surya

Kalpa Surya variety is essentially derived from the CPCRI accession IND 048 Malayan Orange Dwarf originally introduced from Malaysia in 1959 (EC 548007). This population was developed at CPCRI through selection of superior high yielding palms and inter se mating between the selected palms in the population. This variety gives higher yield of 123 nuts per palm per year under irrigated conditions, with 71.18% higher annual nut yield over the local control (COD). In addition to CPCRI, Kasaragod in Coastal Kerala, Kalpa Surya variety was evaluated and found to be a high yielding dwarf variety at AICRP on Palms - Coconut Research Station, Aliyarnagar, Tamil Nadu and Arsikere, Karnataka.

The palms of this variety are dwarf in habit with a compact spherical canopy. The fruits are medium, oval in shape and orange in colour. Under irrigated conditions, the palm attains a height of 6.5 metres at the age of 26 years. Under irrigated conditions, initiation of flowering is observed within three years of planting. However, under rainfed conditions, average time taken for flowering in 50% of the palms in the population is 59 months. The seed nuts of this variety germinate quickly with 50% of the nuts germinating within 66 days after sowing. Germination during storage is also observed in this variety.

Based on the oraganoleptic test; the tender nut water is classified as “very good” in taste. The quantity of tender nut water is around 400 ml with TSS of 6.2. The nutritive value of tender nut water: total sugars – 6.7g/100ml, free amino acids -1.8mg/100ml, sodium – 35 ppm, potassium – 2142 ppm.

Dwarf varieties in general are classified as drought susceptible and recommended for large scale cultivation only under irrigated conditions. This variety is sensitive to drought stress and is on par with the COD variety for this trait. No major pest attacks observed under field conditions. However, palms of this variety are attacked by rhinoceros beetle as well as red palm weevil. It is also moderately affected by eripohyid mite. No major disease outbreaks have been observed under field conditions. However, the palms of this variety are moderately susceptible to bud rot and fruit rot.

The variety Kalpa Surya has distinguishing characteristics of medium fruit husk thickness, long husked fruits, medium husk weight and low shell weight. The variety is recommended for cultivation in the coconut growing tracts of Kerala, Karnataka and Tamil Nadu states as a dwarf tender nut variety in the XXI Biennial Workshop of the All India Coordinated Research Project on Palms during the year 2012. The recommendation is based on the superior performance of the variety at CPCRI, Kasaragod, AICRP on Palms - Coconut Research Station, Aliyarnagar, Tamil Nadu and Arsikere, Karnataka, dwarf plant habit as well as the tender nut water parameters.

The variety Kalpa Surya has the potential to produce about 32083 nuts per year per ha coconut garden, under irrigated and good management and

this can be harnessed to tap the tender nut water requirements.

Tall /Semi Tall varieties

Kalparaksha

Kalparaksha is semi tall variety with higher level of resistance to root (wilt) disease and with sweet tender nut water, developed by Central Plantation Crops Research Institute, Regional Station, Kayamkulam. Kalparaksha was developed as a selection from Malayan Green Dwarf population introduced from Malaysia. Kalparaksha showed 22.4% root (wilt) disease incidence in comparison to 84.0% disease incidence in West Coast Tall (WCT) coconut, fifteen years after planting. The diseased palms of this variety scored an average disease index of 15.5 in comparison to a disease index of 45 in WCT. Kalparaksha attains a height of around 4.14 meters at 12 years of age and comes to flowering by 55 months from planting. Kalparaksha gives an average nut yield of 88 nuts/palm/year with copra content of 185 g/nut, and oil content of 65.5%. With estimated oil yield of 1.87 tons/ha, this variety out yields the popular cultivar WCT in the root (wilt) disease tracts of Kerala and is superior to WCT in all important yield attributes. No major pest attack is observed in this variety in field conditions. However, under large-scale plantings precaution is advised against red palm weevil incidence. Kalparaksha, under disease-free and rain fed condition at the Central Plantation Crops Research Institute, Kasaragod gives an average annual per palm yield of 86.8 nuts/palm with yield of 16.38 kg copra/palm and 10.65 kg oil/palm.

Tender nut water content of Kalparaksha is 290 ml and the tender nut water is sweet to taste and organoleptically graded as 'very good'. The nutritive value of tender nut water of Kalparaksha is as follows: Total sugars - 4.92 g/ml, Potassium content - 2100 ppm, Sodium content - 19.50 ppm. Hence, this variety is also recommended for large scale cultivation as a tender nut variety.

The variety is recommended for cultivation in the state of Kerala by XVIII Biennial Workshop of the All India Coordinated Research Project on Palms.

Chandra Kalpa

The variety Chandra Kalpa was developed by CPCRI, Kasaragod during the year 1985. It is a selection from IND008 Lakshadweep Ordinary (LCT), an indigenous coconut cultivar from Lakshadweep Islands. It resembles WCT in growth habit and fruit characters. However, the fruits of this variety

are comparatively smaller and angular with three prominent ridges seen on the mature fruits. The fruit colour varies from greenish yellow to yellow-green. The average annual yield is 100 nuts/palm and the estimated copra yield of 17 kg/palm/year/year. The variety produces 25% more nuts and 27.5% more copra than the local West Coast Tall at CPCRI Kasaragod.

Fruits are medium sized with an average fruit weight of 800 g, copra content of 176 g/nut and copra oil content of 72%. This variety is suited for production of ball copra. About 6000 to 7000 nuts are required to make one tonne of copra. The oil of this cultivar contains comparatively high concentration of medium chain fatty acids and is preferred for edible purposes. It is also preferred for pharmaceutical industries, as the oil contains high saturated fatty acid with high lauric acid concentration (48.9 %). The tender nut water content is around 285 ml and organaoleptically graded as "good" in taste. The tender nut water has total sugar content of 4.2 g/100ml, sodium content of 50 ppm and potassium content of 2762 ppm. The palms of this variety are also good for tapping 'neera' (inflorescence sap), which can be consumed as such or converted to palm sugar/jaggery.

The palm grows in all types of soil and can withstand moisture stress. This variety was recommended by the VII Biennial Workshop of the All India Coordinated Research Project on Palms, in the year 1985, for large scale cultivation

in the states of Kerala, Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra, based on the performance of this variety at CPCRI, Kasaragod, CPCRI Research centre Kidu and the AICRP on Palms centres.

Kera Chandra

Kera Chandra was developed as a selection from IND014, the exotic accession Philippines Ordinary Tall. The palms of this variety grow to a height of 10-12 m, are regular bearers and produce large, round and green fruits. It is a good yielder with an annual average yield of 110 nuts/palm and copra yield of 20.8 kg/palm/year/year, an increase of 37.5% and 50.7% for nut and copra yield over the local West Coast Tall.

The seed nuts of this variety germinate early, with majority of the nuts germinating within two months after sowing in the nursery.The fruits are large, with mean copra content of 198 g/nut and 66% oil content in copra. Because of the high concentration of saturated fatty acids and high saponification value, the oil of this variety is more suitable for the soap industry.

The variety Kerachandra also has good quantity and quality of tender nut water. The tender nut water content is around 450 ml and organaoleptically graded as "very good" in taste. The tender nut water has total sugar content of 5.86 g/100ml, sodium content of 24 ppm and potassium content of 2273 ppm. The variety is not suitable for ball copra production, since >75% of the nuts get spoiled due to germination during the process of ball copra production.

The variety Kerachandra has distinguishable characteristics of green petiole, with high collar girth, presence of split leaves in seedlings, broad leaflets, many spikelets per inflorescence, very high quantity of tender nut water, green coloured fruits, round fruit shape over polar and equatorial views, broad fruits, round husked fruits and high shell weight. The variety shows superior performance at CPCRI Kasaragod in coastal Kerala and also in the AICRP on Palms centres in Maharashtra, West Bengal, Andhra Pradesh. Because of its high yield potential, Kera Chandra developed by CPCRI was recommended for release as a 'National variety' by the XII Biennial Workshop of the All India Coordinated Research Project on Palms during the year 1995, for commercial cultivation in the West Coast of the country including Konkan Region, coastal Andhra Pradesh and West Bengal.

Kalpa Pratibha

Kalpa Pratibha, developed as a selection from IND 016, Cochin China Tall (CCNT), is a high yielding dual-purpose variety (copra and tender nut variety). The palms are regular bearers and under rainfed conditions commence flowering about 6-7 years after planting in the field. The palms are tall in habit with a compact spherical canopy. The fruits are large, round in shape and predominantly green in colour. The seed nuts germinate faster with 50% nuts germinating in about 62 days after sowing. The variety produces an average of 98 nuts/palm/year.

The average weight of the fruit is around 1332g and from one fruit, on an average, 256.37g of copra (dried endosperm) can be obtained. The copra contains about 67% of oil. The oil extracted from the copra of this variety has 47.81% of lauric acid. The average quantity of tender nut water is 448 ml and the tender nut water is classified as "good" in taste. The nutritive value of tender nut water is as follows: total sugars - 5.5 g/100 ml; free amino acids - 1.1 mg/100 ml; Potassium - 2150 ppm; Sodium - 21.7 ppm.

The variety is relatively tolerant to drought. This variety gives an average yield of 4.07 tons copra/ha; 2.73 tons oil/ha; 15874 nuts/ha (under rain fed condition). The variety is found to be superior to the local control (WCT) and the estimated copra and oil yield per hectare is 40.11 % and 38.05 % higher than WCT, respectively. This high yielding variety will help enhance the coconut productivity in the country. This variety has the potential to produce on an average 23275 nuts, 5.97 tons of copra and 4.01 tons of oil per hectare.

The variety is recommended for cultivation in the states of Kerala, Andhra Pradesh, Tamil Nadu and Maharashtra. Based on its superior performance at CPCRI, Kasaragod in Coastal Kerala and AICRP on Palms Centres Ambajipeta in Andhra Pradesh, Veppankulam and Aliyarnagar in Tamil Nadu and Ratnagiri in Maharashtra, the XVIII Biennial Workshop of the All India Coordinated Research Project on Palms recommended the variety for commercial cultivation during the year 2007. This variety was subsequently released by Central Sub-committee on Crop Standards, Notification and Release of variety and notified vide Notification of Ministry of Agriculture (Department of Agriculture and Co-operation) S.O. 1714(E) dated July 18, 2008.

Kalpa Dhenu

Kalpa Dhenu, developed as a selection from IND 006, Andaman Giant Tall (AGT), is a high yielding and relatively drought tolerant variety. The palms are regular bearers and commence flowering 6-7 years after field planting, under rainfed conditions. The palms of this variety are tall and robust and appear gigantic. The fruits are large, oval in shape and green in colour. The time taken for 50% seed germination is about 99 days. The average yield of this variety is 3.66 tons copra/ha; 2.40 tons oil/ha; 15012 nuts/ha (under rain fed condition). The performance of this variety is found to be superior to the local control (WCT), with 26.07 % higher copra yield and 21.44 % higher oil yield as compared to WCT. This high yielding variety will help enhance the coconut productivity in the country. This variety has the potential to produce on an average 22794 nuts, 5.56 tons of copra and 3.64 tons of oil per hectare.

The average weight of the fruit is around 1381.26g and 256.37g of copra (dried endosperm) is obtained per fruit. The copra contains about 65.5% of oil. The oil extracted from the copra of this variety has 50.26% of lauric acid. The average quantity of tender nut water is 290ml. Based on the oraganoleptic test, the tender nut water is classified as “average” in taste. The nutritive value of tender nut water is as follows: total sugars -4.92 gil 00 ml; free amino acids -1.3 mg/l00 ml; Potassium -2650 ppm; Sodium -24.6 ppm.

The variety is recommended for cultivation in the states of Kerala, Tamil Nadu and the Andaman and Nicobar Islands. XVIII Biennial Workshop of the All India Coordinated Research Project on Palms recommended the variety for commercial cultivation during the year 2007, considering its superior performance at CPCRI, Kasaragod in Coastal Kerala and AICRPP Centre, Aliyarnagar, Tamil Nadu and Andaman and Nicobar Islands from where it was originally collected. Subsequently, Kalpa Dhenu was released and notified by the Central Sub-committee on Crop Standards, Notification and Release of variety vide Notification of Ministry of Agriculture (Department of Agriculture and Co-operation) S.O. 1714(E) dated July 18, 2008.

Kalpa Mitra

Kalpa Mitra, developed as a selection from IND 022, Java Tall (JVT), is a high yielding and relatively drought tolerant variety. The palms of this variety are tall in habit with stout trunk and spherical canopy with large number of leaves. The palms are regular

bearers and commence flowering 7-8 years after planting in the field, under rainfed cultivation. The fruits are large, oval in shape and yellowish green in colour. The seed nuts of this variety are slow to germinate with 50% nuts germinating in about 164 days after sowing. This variety gives an average yield of 3.37 tons copra/ha; 2.24 tons oil/ha; 13973 nuts/ha (under rain fed condition). The variety is found superior over local control (WCT) with an estimated 16.01 % and 13.45 % higher copra and oil yield than WCT, respectively. This high yielding variety will help enhance the coconut productivity in the country. This variety has the potential to produce on an average 22429 nuts, 5.41 tons of copra and 3.60 tons of oil per hectare.

The average weight of the fruit is 1001.19g and, on an average, 241.14g of copra (dried endosperm) per fruit can be obtained. The copra contains about 66.50% of oil. The oil extracted from the copra of this variety has 47.88% of lauric acid. The average quantity of tender nut water is 495ml. Based on the oraganoleptic test, the tender nut water is classified as “average” in taste. The nutritive value of tender nut water is: total sugars -5.7g/1 00 ml; free amino acids -1.3mgll00 ml; Potassium -2150ppm; Sodium 23.5ppm.

The variety is recommended for cultivation in the states of Kerala and West Bengal. The recommendation by the XVIII Biennial Workshop of All India Coordinated Research Project on Palms, in 2007, was based on the superior performance of this variety at CPCRI, Kasaragod in Coastal Kerala and

AICRP on Palms Centre Mondouri, West Bengal. The variety release proposal was approved by the Central Sub-committee on Crop Standards, Notification and Release of variety and this variety was released and notified vide Notification of Ministry of Agriculture (Department of Agriculture and Co-operation) S.O. 1714(E) dated July 18, 2008.

Kalpatharu

Kalpatharu is a high yielding variety, developed by selection of high yielding palms from Tiptur tall coconut population, a popular variety of Karnataka. The palms of this variety are tall with circular crown and are regular bearers and have an economic life span of up to 80 years, under favourable conditions. The average time taken for flowering in the population is about 6 years, under rain fed conditions. The shape of the fruit is oval with husked nuts being round in shape. This variety gave an average nut yield of 117 nuts/annum under rainfed conditions with an estimated annual copra and oil yield of 3.59 t/ha and 2.45 t/ha, respectively. The variety is relatively tolerant to drought and suitable for cultivation under both rainfed and irrigated conditions.

The average fruit weigh of this variety is around 958 g, with mean copra content of 172 g/ nut and oil content in copra of 67.2%. Approximately 5600-6800 nuts are required to make one tonne of copra. The oil contains about 44.7% of lauric acid. The quality of tender nut water is good in taste and the average quantity of tender nut water per nut is around 265 ml. The nutritive value of the tender nut water of Kalpatharu is as follows: total sugars – 5.0 g/100ml; free amino acids -2.9 mg/100ml; Potassium - 3200 ppm; Sodium - 60 ppm. The variety is especially suitable for ball copra production, as spoilage percentage (3.92%) during the process of ball copra production is lower as compared to other released varieties.

CPCRI is a participating institute in developing this variety, proposed for release by AICRPP Arsikere Centre. Kalpatharu was recommended for cultivation in the states of Karnataka, Tamil Nadu and Kerala by XIX Biennial Workshop of the All India Coordinated Research Project on Palms in 2009, based on the superior performance of this variety at AICRPP Arsikere Centre in Karnataka, CPCRI, Kasaragod in Coastal Kerala and AICRPP Centre Aliyarnagar inTamil Nadu. This variety has wider adaptability and would help in enhancing the productivity in the states of Karnataka, Tamil Nadu and Kerala.

Kera Keralam

This variety is developed as a selection from the accession IND 069, West Coast Tall (WCT). WCT is the common tall cultivar, extensively cultivated along the west coast regions of India. The palms are sturdy with compact spherical crown and yields economically for about 75 years or more. A fully grown palm of 27-30 years of age has an average of 36 functional leaves, with spherical or semi-spherical crown. The palms are regular bearers, annually producing about 12-13 inflorescences per palm. The WCT palms normally come to bearing in about 6-7 years, under rainfed conditions. However, under favourable conditions of irrigation and ample sunlight, early flowering within four years of planting has been recorded. The average annual yield under rainfed condition is 80 nuts per palm.

The fruits of the variety weigh about 800-900 g and have a copra content of 176 g/nut, with copra oil content of 68%. The oil of this cultivar contains 44.1 % lauric acid and is preferred for both edible purpose and soap manufacture. The nuts can also be used for preparation of ball copra, since only 9.09% spoilage is observed in this variety during the process of ball copra production. The husk of WCT is of good quality and extensively used for making coir and coir products. The palms of this variety also yield good quality and quantity of inflorescence sap, which can be converted into coconut palm jaggery or sugar.

The WCT palm grows well in all types of soil and is comparatively drought tolerant. Based on the superior performance of the WCT accession provided from CPCRI to AICRP on Palm centres at Aliyarnagar, Ambajipeta, Ratnagiri, Arsikere, the XVIII Biennial Workshop of the All India Coordinated Research Project on Palms during the year 2007 recommended the variety Kera Keralam for large scale commercial cultivation in the states of Tamil Nadu, Andhra Pradesh, Maharashtra, Kerala and Karnataka. The variety was subsequently released by the Central Sub-committee on Crop Standards, Notification and Release for cultivation in the states of Tamil Nadu, Andhra Pradesh, Maharashtra, Kerala and Karnataka and notified in the gazette of India vide Notification of Ministry of Agriculture (Department of Agriculture and Co-operation) S.O. 1979(E) dated August 12, 2010.

Kalpa Haritha

Kalpa Haritha variety is derived from the CPCRI coconut accession IND045, Kulasekharam Green Dwarf (KGD) that was collected from Kulasekharam,

Tamil Nadu and conserved at CPCRI. The variety was evaluated under rainfed conditions for over 50 years and the present selection was made for better performance in terms of yield and tender nut traits. The proposed variety gives an average nut yield of about 118 nuts per palm per year, 3.72t/ha copra and 2.47 t/ha oil under rainfed conditions. The variety gives 48 % more nuts per palm per year, 54 % more copra out turn and over 50 % more oil yield per hectare than the local check West Coast Tall under rainfed conditions

The palms are tall with slight bole at the base and attain an average height of 13.8 m in 50 years after planting. The colour of the petiole is green. The variety bears green coloured, oval fruits and the dehusked fruits are round in shape. The seedlings are vigorous, with green coloured petiole and an one year old seedling, produces on an average about 9 leaves with collar girth of over 17 cm and average height over 160 cm. The palms are regular bearers and commence flowering 45 months after planting under rain fed conditions. The average time taken for flowering of 50% of the palms in the population is 50 months. No major pest attacks and disease out breaks is observed under field conditions. The palms of this Kalpa Haritha are relatively tolerant to eriophyid mite attack and recorded lesser incidence of eriophyid mite amidst heavy infestation on other palms in the vicinity.

The average quantity of tender nut water is about 440ml. Based on the organoleptic test; the tender nut water is classified as “very good” in taste with a TSS of 5.850 Brix. The tender nut water has Na content of 17.5 ppm and K content of 2100 ppm. The average fruit weight of Kalpa Haritha variety is 914 g, with copra content of 216 g/nut, with copra oil content of 66.5%.

Kalpa Haritha variety has been categorized as relatively tolerant to moisture stress as the palms are high yielding under rainfed conditions when compared to the local check WCT. The variety Kalpa Haritha has distinguishable characters of medium category with respect to time taken for inflorescence emergence, medium inflorescence length, many number of female flowers per inflorescence, medium duration of female phase, presence of intra spadix overlapping of male and female phases, oval fruit shape and thin endosperm. About 10 % variability is expected due to the inherent heterozygosity of the crop and hence, seedling selection is to be followed. This variety is propagated through seeds. Controlled

pollination between the selected parental palms followed by seedling progeny selection is to be followed.

Based on the superior performance of this variety at CPCRI, Kasaragod in coastal Kerala (in sandy loam soil) and CPCRI Research centre, Kidu, Karnataka (in laterite soil), the XXI Biennial Workshop of the All India Coordinated Research Project on Palms during the year 2012 recommended the variety Kalpa Haritha for large scale commercial cultivation in the Coconut growing tracts of Kerala and Karnataka states.

This superior high yielding variety will help in enhancing the coconut productivity as it has the potential to yield 36350 nuts per ha which will provide 6.56 tons copra per ha, yielding upto 4.3 tons oil per ha.

Kalpa Shatabdi

This variety is developed as a selection from the accession IND 034, San Ramon Tall (SNRT). SNRT is the introduced tall cultivar from Philippines in 1955. SNRT is the tall cultivar, with spherical canopy and slight bole at base with closely arranged leaf scars. The palms normally come to flowering 72 months after planting, under the rain fed conditions. It is a high yielding, dual purpose variety; with large attractive greenish yellow fruits weigh about 1965 g, suitable for copra and tender nut production. It gives greater volume (612 ml) of good quality tender nut water and has a copra content of 272.9 g/nut with copra oil content of 64%. It is unsuitable for ball copra production due to early germinating nature of the fruits. This variety shows lesser incidence of rhinoceros beetle damage. Based on the superior performance of the SNRT accession, ICAR- CPCRI Centenary year, XXV AICRP Group meeting-2016 recommended the variety Kalpa Shatabdi for large scale commercial cultivation in the states of Kerala, Karnataka and Tamil Nadu. ■

Timely management of Nutrient Deficiencies for reaping higher yield

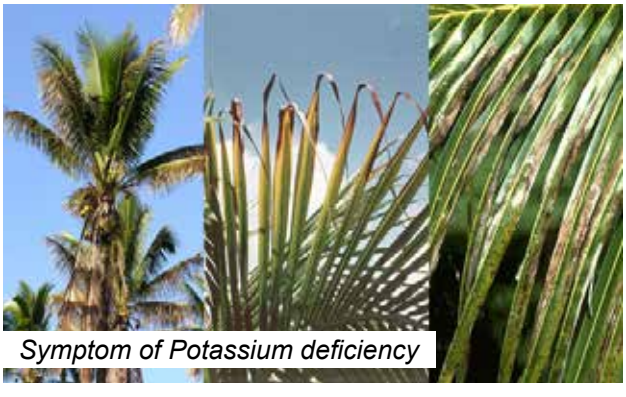
R. Jnanadevan, Deputy Director (Retd), CDB, Kochi - 11

Coconut is a perennial crop that absorbs large quantity of nutrients from the limited volume of soil in the basin throughout its existence. In general, a palm yielding up to 100 nuts per year abrsorbs the three major nutrients viz; Nitrogen, Phosphorous and Potash from the soil. Coconut also requires other minor nutrients viz; Boron, Magnesium, Sulphur, Chlorine, Manganese, Iron, Zinc, Copper and Molybdenum in small quantities for successful crop production. Regular supplementing of these nutrients in the soil by adopting proper application of fertilizers and manures is essential to sustain crop yield. Due to continuous cultivation, coconut without regular application of optimum doze of manures and fertilizers lead to nutrient deficiency disorders in traditional coconut belts. Deficiency of major and minor nutrients is reported from most of the traditional coconut growing areas in India. Phosphorous deficiency is not generally noticed in coconut gardens. Its application can be skipped for a period of few years if the phosphorous available in the soil is more than 20 ppm. Powdered rock phosphate is the best and cheapest source of phosphate fertilizer for acidic soils. Potassium (K) Boron (B) Magnesium (Mg) and Nitrogen (N) are four major plant nutrients commonly found deficient in coconut plantations. Its deficiency adversely affects the growth of production in coconut palms. The wide spread deficiency of these nutrients is the limiting factor for increased productivity. The palm growth, nut and copra production get decreased due to deficiency of these nutrients. Generally severe deficiency of these nutrients produce characteristic visual symptoms on the leaves. Thus the condition can be easily identified by the farmers in the field by observing the symptoms. Visual Symptoms of deficiency of these nutrients and corrective measures recommended are briefly explained in this article.

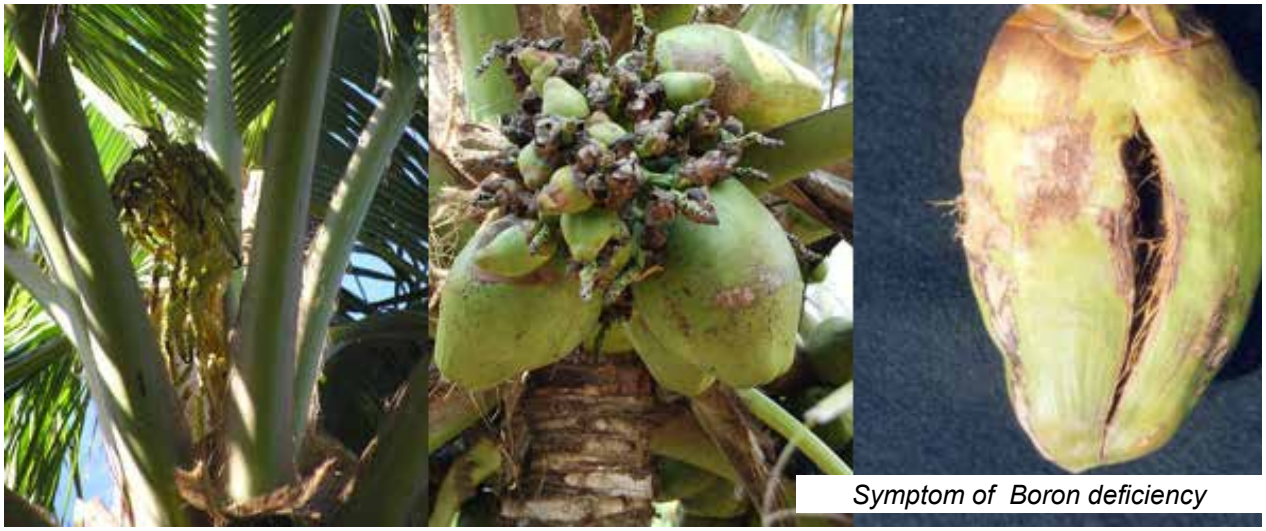
Potassium (K_2O)

It is one of the major nutrients required for coconut in large quantities compared to other crops. Coconut requires 1200 gm of potassium per palm per year where as other plantation corps like cashew and areca nut need 750 gm and 140 gm respectively per plant per year only. Since coconut palms remove large quantity of potassium, its deficiency disorders are commonly reported by farmers due to lack of regular application of manures to supplement its removal.

Symptoms of potassium deficiency is first observed in mature leaves where scattered rust coloured spots appear on either side of the midrib of the entire leaflet. The leaflets appear slightly yellowish in colour. Yellowing is seen more pronounced towards the tips. Gradually the spots enlarge and form large brown patches with leaflet tips showing distinct scorches. The crown appear yellowish with the lower half showing slight orange in colour. Ultimately the whole crown becomes smaller and yellowish orange.



Symptom of Potassium deficiency



Symptom of Boron deficiency

Its deficiency affects all production factors especially the nut set, leading to production of less number of bunches and female flowers.

To correct the potassium deficiency, application of potassium manures and fertilizers is advocated. The general recommendation for fertilizing adult bearing palm is to apply 1200 gm of K_2O per palm per year in two split dozes ie; 1/3 during May-June and 2/3 during September- October. To supplement this quantity potassium, regular application of two kg muriate of potash (MoP) fertilizer per tree is required after neutralizing the acidity of soil. In the case of acidic soil, application of one kg dolomite per palm per year is required. Generally potassium deficiency occurs due to suspension of potassium fertilizer application by farmers. If the symptoms are not disappearing in spite of regular application of fertilizers and manures, apply additional 500 gm muriate of potash to adult palm to correct its deficiency.

Boron (B)

Deficiency of boron is a limiting factor for increasing coconut production observed in traditional coconut growing belts. Boron deficiency is generally noticed in the coconut growing soils of Kerala, Assam and Lakshadweep Islands. Emergence of shorter leaves with deformed and crinkled leaflets is the first symptom of boron deficiency. Boron causes characteristic malformation of leaves like hook leaves, nut cracking, drying of female flowers etc. The leaflets are wedded together and the tip of the affected leaf appear like a hook. The lower basal region of the frond normally will not produce any leaflet. Crown rot disease or crown choke disease appear due to Boron deficiency. Inflorescence shows necrosis. In the advanced stage, the palm has only a central bulbous bud that does not develop any more, surrounded by some petioles without leaflets and finally, the palm dies. The death of the affected palm is not sudden, but it slowly loses vitality and finally succumbs within 3-4 years. The critical stage at which the palms will not respond to treatment is when the leaves are withered and have a severely stunted apical leaves, crinkled leaves, and when some leaves lack leaflets. Button shedding and production of barren nuts are the common symptoms associated with boron deficiency. Other associated symptoms include 'Hen and Chicken' symptom (few under developed nuts / small sized nuts along with full developed nuts), partial filling of endosperm, nut cracking etc

Soil application of Boron containing fertilizer borax 50 gm to 100 gm per tree based on the intensity of crown chocking symptoms twice at monthly intervals after appearance of the first symptom is recommended to correct the deficiency. In the root (wilt) disease affected areas, it is recommended to apply Borax @ 300 gm/seedling and @ 500 gm/ adult tree to correct its deficiency. Application of 10% solutions of sodium borate as foliar spray is recommended in Srilanka. The spraying has to be done at every 10 days intervals up to one month. Timely application of Borax is very important to correct its deficiency and to sustain growth for better yield of coconut. Coconut palm will not respond in the advanced stages of its deficiency. Hence application of Boron at initial or middle stage of symptoms is essential to correct its deficiency.

Magnesium

Deficiency of magnesium can be identified by farmers by observing the yellowing of leaflets of mature leaves fronds. The leaflets would be pale yellow with a green band on either side of the midrib. The basal areas of leaflets remain green thereby showing a green band on either sides of rachis of whole frond. Gradually the leaflet tip dry giving the appearance of scorching. The crown leaves also remain pale yellow. In advanced stages, yellowing would be more conspicuous in the lower half of the crown.

To correct the magnesium deficiency, application of Magnesium sulphate 500 gm per tree or dolomite one kg per tree year is recommended. This application should be continued until the full recovery of visual symptoms. As a long term preventive measure against magnesium deficiency, ground dolomite lime stone (dolomite) should be applied to yielding palms along with other fertilizer application. For young palms 500 gm dolomite should be applied along with the application of recommended dose of fertilizers.

Symptom of Magnesium deficiency

Yellowing of palm due to Nitrogen deficiency

Nitrogen

In nitrogen deficient coconut palms general yellowing of all leaves is noticed. In the initial stage of deficiency the crown as a whole appears pale green. As the deficiency advances, the crown appears clearly yellowish before turning reddish gray. In the advanced stage the crown become progressively smaller with tapering of stem. Many inflorescences are seen aborted and the number of female flowers is less.

Regular application of nitrogenous fertilizers and manures will help to correct Nitrogen deficiency. In general, application of one kg urea per palm per year in two split dozes is recommended for sustained supply of nitrogen to coconut palms. If deficiency symptoms appears even after regular application of manures and fertilizers apply additional 100 gm urea per palm for young palms and 200 gm of urea to yielding palms to correct the deficiency. Growing of leguminous green manure crops *in situ* and incorporation of the same in to the soil also help to correct nitrogen deficiency. Moreover recycling of palm waste is much beneficial especially for maintaining the status of major and micro nutrients. Palm wastes like coconut leaves, crown wastes, dried spathes, husk etc. are used for recycling to replenish the nutrient status of soil.

In order to ensure proper growth, flowering and fruiting and higher yield optimum concentration of nutrient should be maintained in the soil through regular application of manures and fertilizers in time. Deficiency of the four nutrients described above is commonly noticed in traditional coconut growing areas due to continuous cultivation without proper fertilizer management. Regular and timely application of fertilizers or manures is essential to those palms showing the visible symptoms in time to correct its deficiency. If farmers are not able to diagnose the cause of symptoms by visual observation they are advised to contact the nearby Agriculture or Horticulture Officers of the state government or Technical Officers of Coconut Development Board for proper remedial measures in time.

Farmers are advised to keep an eye on coconut palms to identify nutrient deficiency symptoms at an early stage and correct it through the proper fertilizer and manure management to restore health of the palm and to reap higher yield. ■

RAMBUTAN,
the exotic fruit
A money spinner for the Chowtas

Abe Jacob
Deputy Editor, CDB, Kochi -11

Chandrasekhar Chowta from Kasaragodu district, Kerala has set off a successful trial of intercropping rambutan in his coconut garden. Around 1000 rambutan plants have started yielding from the fourth year onwards in the Chowta farm. This new generation, much sought after fruit which has come to India from Malaysia and Thailand is creating a novel trend in the fruit market in country. Presently Rambutan fruit fetches around Rs. 200 per kg.

The village of Miyapadavu where the Chowta's farm is situated with its unique geographical features, language and culture, has more resemblance to a Karnataka village. Few small shops, community hall and schools are the only few old buildings of this village which is 40 km away from Kasaragod, the district head quarters.

Chandrasekhar Chowta,the owner of the chowta farm a very simple person in appearance is a graduate in Botany with post graduation and doctorate in Cytogenetic and Radiation Biology. He started his career as a teacher and later on his

The rambutan is a large, round topped, much branched evergreen tree. The crop is indigenous to the Malayan archipelago and is grown in the subtropical regions of South-East Asia. The fruits of rambutan are hairy and is very delicious, juicy and attractive. The one-seeded fruit is large, ovoid in shape and borne in clusters of 10-12 fruits. The soft curved spines (hairs) covering all the pericarp (rind) may be red or yellow in colour.

passion for agriculture made him quit his job and he became a full time farmer. Chowta lives in a joint family in a Victorian type bungalow in the Chowta farm itself. Chowta brothers are five in number. The eldest is Krishnananda Chowta who is well proficient in Tulu and Kannada and has made remarkable contribution to Kannada literature. The second is Chandrasekhar Chowta who is taking care of the 50 acre family property. His brothers Prabhakar Chowta and Manohar Chowta are also living with him in the same house. Every year all the family members meet together once and Chandrasekhar Chowta presents the income and expenditure statement of that year's agricultural activities. The profit share of each member which will be around lakhs will be distributed to each member on the same day.

The Chowta garden is rich with all crops like coconut, arecanut, pepper, paddy, rubber, cocoa, banana etc. Even though paddy farming is not profitable, the family continues it, to meet the

Rambutan, less known fruit of subtropics

The rambutan Nephelium lappaceum belonging to the family Sapindaceae is a large, round topped, much branched evergreen tree. The crop is indigenous to the Malayan archipelago and is grown in the subtropical regions of South-East Asia.

The tree reaches a height of 15 m with compound leaf having 3-4 pairs of leaflets, each being about 15 cm long and 5 cm wide. The flowers are small, borne on terminal and axillary inflorescence. The fruits of rambutan are hairy and hence it is also termed `hairy litchi'. It is very delicious, juicy and attractive. The one-seeded fruit is large, ovoid in shape and borne in clusters of 10-12 fruits. The soft curved spines (hairs) covering all the pericarp (rind) may be red or yellow in colour.

The fruit contains a big seed, which is surrounded by pearl white aril (flesh). The white, translucent, sub-acid, sweet flavoured aril is the edible flesh of the fruit. The taste is rather flat or insipid. It can be propagated vegetatively or by seeds. Seedlings are very variable because they produce both male and female plants (dioecious).

Normally vegetative propagation by means of patch budding is adopted. It can be planted at 7 x 10 m distance accommodating 140 plants per hectare. The tree is a shade loving fruit crop and hence can be grown as an intercrop in coconut plantations.

Shri. R Jnanadevan retired

Shri. R Jnanadevan, Deputy Director, Coconut Development Board retired from the service of the Board on 2nd July 2019. He has taken his masters degree in Agricultural Extension from Kerala Agriculture University and started his official career as Agriculture Officer in Kerala in 1985. He joined the Board in 1988. He served as faculty member on deputation in Agriculture Cooperative Staff Training Institute, Trivandrum from 2000 to 2001, as Director in Vegetable And Fruit Promotion Counsil Kerala (VFPCK), and as Deputy Director (Marketing) in Directorate of Cashew and Cocoa Development, Kochi. He was serving as the Editor of Boards publications, viz. Indian Coconut Journal, Indian Nalikera Journal and Indian Thennai Idhazh. He was the Vigilance Officer and Grievance Officer of the Board.

family's daily consumption need. Pepper is cultivated in a small area and rubber is grown in around three acres. Arecanut is one of the most profitable of all crops in the Chowta garden. He gets around 25 tonne Arecanut in an year ie around Rs. 50 to 60 lakhs gross income from the Arecanut alone. He also gets around five quintal cashew nut in an year.

The Chowtas are having a 10 acre demonstration cum seed production farm wherein around 714 coconut mother palms of various varieties viz. Gangabondam, Malayan Dwarf Yellow, Pratap, Chowghat Dwarf Orange, Chowghat Dwarf Green, East Coast Tall etc. are planted. Now there are around 2500 yielding coconut palms in the Chowta garden. A small nursery is also attached to the farm where seedlings are sold @ Rs. 200 to the farmers.

On realizing the importance of Food Safety Standards, the Chowtas have made certain changes in the farm operations. He has started planting fruit crops along with coconut. It was on a trial basis that he planted rambutan plants as intercrop in his coconut garden. Initially he purchased 400 seedlings in 2014 and in 2015 he planted another batch of 600 rambutan seedlings. The rambutans are planted among his dwarf variety coconuts. The coconut trees are planted at a distance of 30 meter and the rambutans are planted in between each coconut. Thus 75 rambutan plants are planted among 75 coconut palms.

The rambutans are planted in between his 14 year old coconut palms as well as among the newly planted palms. He has planted N-18 and Wrong Grain rambutan varieties which are having good demand in the market. Out of the initially planted 400 rambutan seedlings, 350 have started yielding from last year onwards with around 150 kg yield

from each tree. Around 15 tonne fruit was sold to the wholesale merchants of Mysuru at an average price of Rs. 175 per kg. This year the Chowtas have started taking yield from the whole 900 trees. The market for Rambutan was opened @Rs.350 per kg during the last week of March. Later on the price decreased to Rs. 250. Chandrasekhar applies only organic manures for the rambutan crop. Alongwith harvesting, the trees will be pruned and then the manures will be applied. Along with coconuts, drip irrigation is facilitated in the garden for rambuttan. The same will be done twice in an year and the initial dose will be given again when the trees start flowering.

The Chowtas are expecting a yield of 70-75 tonne rambutan this year. The speciality of the rambutan fruit is that it reaches market when the usual fruit season gets over. Due to lack of heavy rain, the fruits were ready to harvest early and the product got good demand in the market. Earlier, Mysuru was the main market and now traders from Kozhikode, Kerala have also started to purchase Chowta's rambutan.

The rambutan trees decorated with the red fruits of the Chowta garden is a beautiful treat for the eyes. Chowta affirms that intercropping of rambutan in coconut garden is definitely having great potential as a money spinner for the coconut farmers. ■

Pineapple- a profitable fruit intercrop for coconut farmers

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Introduction

Among the plantation crops, coconut is the major crop grown both under plantation and homestead management system. It provides livelihood security to several millions of people across the world, and the capacity of coconut in providing improved nutrition, employment and income generation are well known. The coconut palm exerts a profound influence on the rural economy of the many states where it is grown extensively and provides sustenance to more than 10 million people in the country. The processing and related activities centered on the crop generate employment opportunities for over three million people in India. Coconut is a major plantation crop of coastal India covering an area of 2.18 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 and farming system make it an economically viable crop in small holdings.

Cropping/farming systems

Coconut interspaces provide ample scope for mixed and intercropping and about 70-75% of the plantation area can be utilized for cropping systems. The pioneering effort of CPCRI has resulted in the development of technologies for coconut based inter/mixed, multi-storied multi-species cropping systems and these are being widely adopted by the farmers. The high-density multi-species cropping system and coconut-based mixed farming system, involving annuals/biennials/perennials grown in different tiers by exploiting soil and air space more efficiently and integrating with poultry and animal husbandry, helps to maximize profits and can even buffer the price crash of the main crop. For maximizing economic returns, high value pineapple fruit crop has been recommended in the palm-based cropping system. The net return per rupee invested from the cropping/farming system ranges from 1.7 to 2.7. It has been already proved by researchers that growing of pineapple crop in coconut improves the productivity of coconut. But this needs supply of irrigation for the component crops. Coconut is an irrigated crop in many states. This gives ample opportunity to grow pineapple as an intercrop in the coconut gardens. The recyclable biomass from coconut-based cropping system varies from 15-20 t/ha. This can be conveniently utilized as vermicompost which can reduce the requirement of chemical input

to the system. This will pave way for organic farming for improving the health of the soil and for sustained productivity.

Pineapple

The pineapple *(Ananas comosus (L.) Merr.)* is one of the leading commercial fruit crops of the tropics. Pineapple is also a commercially important fruit crop of India with around 90,000 ha area under this crop, 15.27 lakh tonnes annual production and 15.3 tonnes /ha productivity (Anonymous, 2018). It is one of the choicest fruit all over the world because of its pleasant taste and flavour. Pineapple is a good source of vitamin A and B and fairly rich in vitamin C and minerals like calcium, magnesium, potassium and iron. It is also a source of bromelain, a digestive enzyme. Pineapple is a hardy plant; requires very less water and hence suitable for most parts in coastal and inlands of south India. The major pineapple producing states in India are Assam, West Bengal, Karnataka, Meghalaya, Manipur, Arunachal Pradesh, Kerala and Bihar. Currently, India produces 1.53 million tonnes of pineapple with productivity of 15.3 t/ha. Although coconut area of coastal states has potential scope for cultivating pineapple, it has not been done commercially but for few farms. Utilization of available inter space in coconut which is otherwise fallow by cultivating improved varieties of pineapples will fetch good profit to the coconut farmers.

Varieties

Kew, Giant kew, Charlotte Rothschild, Champaka, Mauritius, Red Spanish, Queen, Ripley Queen, Victoria are varieties of pineapple suitable for cultivation.

Improved package of practices for cultivation of pineapple under coconut

▶ *Land preparation*

The field should be well-ploughed and made to fine tilth. The ideal time of planting would be April-May or August to October in order to avoid harvests during rainy seasons.

▶ *Planting method*

The propagation materials are used are suckers and slips. Uniform sized slips weighing around 350g are used for planting. Suckers and slips are usually preferred for planting since they flower comparatively earlier than crown. The suckers are

planted in trenches with a spacing of 90x60x30 cm to accommodate 43,500plants/hectare as a sole or main crop. In Goa, the local variety is planted as intercrop in slopes under partial shade of cashew and other wild trees, accommodating around 20,000 plants / hectare.

▶ *Manures and fertilizers*

Pineapple is a shallow feeder with high N and K requirement. A dose of N, P_2O_5 and K_2O at 12, 4 and 12g/plant/year respectively is optimum for pineapple cultivation. Application of fertilizer under rain fed conditions should be done when moisture is available i.e. during monsoon season. (Table 1)

▶ *Inter cultivation*

Earthing up is an essential operation which result in good anchorage. It is more important in ratoon crop. Mulching is essential to conserve soil moisture as well to check weed growth. Spraying Glyphosate @ 4-5 ml/L or Diuron 2 4 ml/ l is recommended to control the weeds. Fruit weight increases with increasing number of suckers per plant, while more number of slips delays fruit maturity. Hence desuckering can be delayed as much as possible, while slips are recommended for removal as soon as they attain the size required for planting.

Table 1. Fertilizer schedule for soil application on pineapple

Month after planting	N g/plant /year	Urea g/plant /year	P_2O_5 g/plant /year	Rock phosphate	K_2O	MOP
0	-	-	4	13.5	-	-
2	2	4.4	-	-	-	-
4	2	4.4	-	--	-	-
6	2	4.4	-	-	6	36.0
8	2	4.4	-	-	-	-
10	2	4.4	-	-	-	-
12	2	4.4	-	-	6	36.0
Total	12	26.40	4	13.5	12	72.0

Flower regulation using growth regulators

Normally, pineapple flowers 10-12 months after planting and fruits are ready for harvest after 5-6 months of flowering. Besides the time of planting, flower induction practices with certain chemicals or growth regulators influence the season of harvest. The planting and flower induction schedule can be planned as follows so as to accomplish staggered harvest and unbroken market availability throughout the season ie from October to May.

Table 2: Flower regulation for staggered harvests

Month of Planting (1 year)	Month of application of growth regulators in the 2 year	Months taken for flower induction	Harvesting month
April	March -April	1-2	October-November
May	April-May	1-2	November - December
August	July-August	1-2	February-March
September	August-September	1-2	March -April
October	September-October	1-2	April- May
November	October-November	1-2	May-June

Although, growth regulators or chemicals can induce flowering at any stage of the plant growth, forcing the plants to produce flowers at an early stage reduces fruit size. Therefore, when plants of optimum size (35- 40 fully grown and active leaves) are induced to flower, better fruit size is obtained without any adverse effects on the ratoon crop.

Harvesting and yield

Pineapple plants flower 10-12 months after planting and fruits become ready 15-18 months after planting.

Table 3: Yield potential of pineapple varieties evaluated

Variety/Yield	Main crop (t/ha	Ratoon crop (t/ha)
Giant Kew	90-100	60-65
Queen	75-80	50-60
Local	50-60	40-45

Pineapple as inter crop in coconut garden

Estimated income from pineapple intercrop

The estimated income from main crop of 'Giant Kew' variety grown in one ha. coconut plantation would be around Rs. 3 to 4 lakhs from 49.27 tonnes (Rs. 8/- per kg average wholesale price for pineapple during 2016; NHB). In first and second ratoon crops, income would be Rs. 2-3 lakhs and Rs. 1 lakhs/- from 36.84 and 16.88 tonnes /ha yield, respectively. This is an additional income besides regular income from coconut. The additional side suckers and slips produced also fetch margin to the farmers. The cost of suckers varies from Rs 2 to Rs 4 per sucker. Pineapple biomass like leaves and crowns can be utilized for composting and recycling nutrients thus reducing fertilizer costs. Pineapple biomass can be a better and easier material to extract bioethanol than from other sources like algae and fish biomass *(Abu Osman et al, 2012).*

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Coconut Development Board
[MINISTRY OF AGRICULTURE & FARMERS WELFARE, GOVERNMENT OF INDIA] KOCHI, KERALA. PH : 0484-2377266, 67

Meeting on implementation of CDB schemes held

A joint meeting of the state government officials and CDB officials was held under the chairmanship of Smt. V. Usha Rani, IAS, Chairperson, Coconut Development Board on 4th July 2019 at National Institute of Agricultural Extension Management (MANAGE), Hyderabad to discuss on the implementation of CDB schemes during 2019-20.

Chairperson, CDB welcomed the participants and briefed that the purpose of the meeting is for ensuring effective implementation of CDB schemes under which a total allocation of Rs. 211.90 crore has been made for 2019-20.

CDB is giving more importance to area expansion. The area under coconut in the country especially in traditional coconut growing areas has become stagnant and the productivity is diminishing. Hence, the target under area expansion for the year 2019-20 has been increased to about 25,000 ha. To achieve the targets, the Chairperson called for the collaborative efforts of the State Agriculture and Horticulture Departments.

She pointed out that the current annual production level of 35 lakh seedlings is much low compared to the projected demand of 100 lakh seedlings. The allocation for production of seedlings by government and private sector have been substantially increased to more than Rs. 10 crore during 2019-20.

The current level of value addition in coconut sector in the country is very meager compared to the other coconut producing countries. Considering the huge scope for value addition in the country, which will benefit the farmers for sustainable income, an amount of Rs. 40 crore is allocated during 2019-20. Workshops and seminars and campaigns etc. at State and District and Block level will be conducted for the farmers and rural entrepreneurs. Extending the benefits of the scheme adhering to the season for various agricultural operations like preparatory works, planting, fertilizer application, nursery activities, plant protection operations etc. will also be given importance. The officers were requested to take up action at appropriate levels for improvement of the coconut sector in their respective States for the effective implementation of the Annual Action Plan 2019-20 of the Board.

The Chief Coconut Development Officer, Shri. Saradindu Das, CDB made a presentation on the activities of the Board, scheme provisions, focus areas identified for 2019-20, targets allocated for different States etc. A presentation on the value added coconut products, their benefits and financial assistance extended under TMoC was also made.

Dr. Ch. Padmavathi, Deputy Director (Hort.), Govt. of Andhra Pradesh, Shri. N.G. Gandhi, Deputy Director (Agri.), Administration of UT of Dadra & Nagar Haveli, Shri. Anant P Hoble, Asst. Director of Agriculture, Govt. of Goa, Shri. R.H. Ladani, Deputy Director (Hort.), Rajkot Division, Govt. of Gujarat, Shri. Alpesh M Datroja, Deputy Director (Hort.), Gir Somnath Division, Govt. of Gujarat, Shri. K. Dhanraj, Joint Director of Horticulture (Plantation Crops and Plant Protection), Govt. of Karnataka, Shri. Suresh V. Bhalerao, Deputy Director (Hort.), Govt. of Maharashtra, Shri. Suvash Chandra Mohanta, Deputy Director (Hort.), Govt. of Odisha, Shri. M. Vedhachalam, Additional Director (Hort.), Govt. of Puducherry, Smt. M. Ponmalar, Deputy Director (Agri.), Govt. of Tamil Nadu, Shri. V. Udaya Kumar, Horticulture Officer, Govt. of Telangana, Shri. Venu Madhav, Horticulture Officer, Govt. of Telangana, Smt. T. Bala Sudhahari, Director i/c, CDB, RO, Chennai, Dr. Rajat Kumar Pal, Deputy Director, CDB, SC, Odisha, Shri. Pramod P Kurian, Assistant Director, CDB, SC, Thane, Shri. Jayanath R, Assistant Director, CDB, SC, Vijayawada, Andhra Pradesh, Smt. Jayashree A, Development Officer, CDB, HO and Kumaravel S, Development Officer, CDB, attended the meeting and actively participated in the discussions.

136th meeting of Coconut Development Board held

The 136th meeting of Coconut Development Board was held on 23rd June 2019 in the Board Room of Coconut Development Board, Kochi under the Chairmanship of Smt. Usha Rani IAS, Chairperson, Coconut Development Board. Members of the Board, Dr. K. Muralidharan, Director i/c, CPCRI, Shri P.C. Mohanan Master, Kerala, Shri P.R. Muraleedharan, Kerala, Shri S. Mohan Raj, Tamilnadu, Shri M.R. Shankara Narayan Reddy, Karnataka,Smt. Daksha Rami, Gujarat and Shri Sanjeev Kumar Singh, Bihar, Shri Saradindu Das, Chief Coconut Development Officer and Shri R. Madhu, Secretary, Coconut Development Board attended the meeting.The meeting approved the Annual Action Plan of the Board for the financial year 2019-20.

Agri Intex 2019 Trade Fair

Coconut Development, Regional Office, Chennai participated in Agri Intex 2019 Trade Fair held at CODISSIA, Coimbatore from 12th to 15th July 2019. Coconut Producer Companies from Tamil Nadu viz; M/s. Pollachi CPC, M/s Vinayaga CPC, M/s. Coimbatore CPC, M/s. Madathukulam CPC and M/s. Kanyakumari CPC and M/s. Vadakara CPC from Kozhikode, Kerala, M/s. Mathura Foods, M/s. Super Coco, M/s. Wettree, M/s. Sakthi Coco and M/s. Parasakthi Tools and Implements displayed their products and services in the Board's stall.

Farmers, students and entrepreneurs from various districts of Tamil Nadu and other states visited the CDB stall . The visitors were briefed about various schems of the Board viz. TMOC, AEP, Nursery, Coconut Palm Insurance etc.

Health Tourism Expo

Coconut Development Board participated in the seventh edition of Kerala Health Tourism expo on July 3rd and 4th in Kochi . The two-day summit was organised by the Confederation of Indian Industry (CII) in association with the Services Export Promotion Council (SEPC). Virgin Coconut oil manufacturers M/s. Keratech and M/s. Pranathmaka Ayurvedic Pvt. Ltd. displayed their products in the Board's stall.

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Cultivation practices for coconut-August

New planting

Plant the coconut seedlings after the cessation of the monsoon in low lying areas subject to inundation during monsoon.

Incorporate green manure legumes into coconut basin / interspace

Green manure crops sown in the coconut basin or in the interspace of coconut gardens have to be incorporated into the soil if they have attained 50% flowering. In the coconut basin the green manure, legumes can be incorporated by using a spade. If tractor is used for incorporating the green manure in the interspace of coconut garden, care should be taken to avoid injury to the coconut trunk.

Nursery management

If sufficient moisture is not available due to insufficient rainfall, continue irrigation for the seedlings in the nursery until rains set in to provide sufficient moisture. Weeding has to be done wherever necessary.

Drainage

Wherever water logging is experienced provide drainage channel to drain the excess water. If continuous heavy rain occurs, make raised bunds around the planting pits newly planted with coconut seedlings to avoid entry of water into the pits.

Manuring

In rainfed areas, circular basins of 1.8 m radius and 25 cm depth may be dug during the fag end of August and green leaf or compost or farm yard manure may be spread at the rate 50 kg per palm basins. The remaining two-third of the recommended dose of fertilizers may be spread over the green leaf or compost and covered. Application of 500 g N, 320 g P_2O_5 and 1200 g K_2O per palm per year is generally recommended for adult plantations. To supply two-third of the above nutrients it is necessary to apply about 0.67 kg urea, 1 kg rock phosphate (in acidic soil) or 1.4 kg Super Phosphate (in other soils) and 1.35 kg of Muriate of potash (MOP). Whereever boron deficiency is observed borax can be applied @100 g/palm. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided.

Moisture conservation practices

Most of the coconut growing tracts in the country received less than average monsoon showers during this season. The month of June recorded 40-50% less rainfall compared to the average. Same trend is being observed during July also. The erratic behaviour of south-west monsoon indicates the significance of conserving each drop of water received. Depending

upon the topography and soil type the following soil and moisture conservation practices can be adopted in coconut gardens.

Mulching

In order to conserve soil moisture in the coconut plantations, mulching with various types of organic materials can be practiced. The best time for mulching is before the end of the monsoon and before the top soil dries up. For mulching, cut coconut leaves into two or three pieces. To cover 1.8 m radius of coconut basin, 10 to 15 fallen coconut leaves are required and can be spread in two to three layers.

Mulching with composted coir pith to 10 cm thickness (approximately 50 kg/palm) around coconut basin is also an ideal method to conserve moisture. Coir pith can hold moisture five times its weight. Due to its fibrous and loose nature, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil. The applied material may last for about 1 to 2 years. Coconut husks are also used as surface mulch around the base of the palm. It can hold moisture to the tune 3 to 5 times of its weight. Approximately 250 to 300 husks will be required for mulching one coconut basin. Mulching is usually done up to a radius of 2 m leaving approximately 30 cm near the palm. Two layers of husk may be buried in the coconut basin with the concave side facing upwards. These layers facilitate absorption of moisture. Above this, another layer of coconut husk is placed with the convex side facing upwards to arrest evaporation. Effect of this mulch lasts for about 5-7 years.

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 1.2 m width and 0.6 m depth between rows of palms with concave side of husks facing upwards and each layer is to be covered with soil.

Catch pit filled with coconut husk

Catch pits can be constructed at 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 may be planted on it. This pit is also to be 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 are to 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 deposited 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 could 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.

Plant protection

August marks the transition phase between the two monsoon periods. Since the quantum of monsoon showers had dropped significantly, there is more emergences of sucking pests in this phase, especially the coried bug and spiralling whiteflies. Extreme care should now be focussed on the early diagnosis of coreid bug incidence as this pest causes a greater damage on the nut yield potential in different parts of the country more specifically in the Southern Kerala. In areas where rugose spiralling whitefly was not reported so far, this pest could emerge as well for which greater emphasis is laid on biological control. Greater emergence of the killer disease, bud rot is more visible in this part of the year for which adequate prophylactic measures need to be undertaken to tackle this problem. Weakening monsoon showers as well as weather dynamics favoured a major shift in the pest and disease kinetics invading coconut, and therefore warrants systematic monitoring and timely prophylactic measures.

Pests

▶ *Rhinoceros beetle (Oryctes rhinoceros)*

Being a ubiquitous pest, the incidence of rhinoceros beetle is quite common during all periods however its damage is well pronounced during monsoon phase when seedlings are also planted. In seedlings just planted, the spear leaf gets damaged and distorted by beetle damage. Juvenile palms are also prone to pest attack and sometimes appearing as elephant tusk-like symptoms. Damaged juvenile palms are stunted and get delayed in flowering. Of late incidence of nut boring symptoms are also noticed. Moreover, the attack by rhinoceros beetle would invariable incite egg laying by red palm weevil as well as entry of bud rot pathogen in this period.

Management

- Prophylactic treatment of top most three leaf axils with either botanical cake [Neem cake /marotti cake


Life stages of the pest


Nut damage


Elephant-tusk like symptom


Metarhizium packets

/ pungam cake (250 g)] admixed with equal volume of sand or placement of 12 g naphthalene balls covered with sand.

- Routine palm scrutiny during morning hours along with brushing of teeth and hooking out the beetle from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.
- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.
- Dairy farmers could treat the manure pits with green muscardine fungus, *Metarhiziumanisopliae* @ 5 x 1011 /m3 to induce epizootics on the developing grubs of rhinoceros beetle. Area-wide farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.
- Incorporation of the weed plant, Clerodendron infortunatumin to the breeding pits caused hormonal irregularities resulting in morphogenetic transformational aberration in the immature stages of the pest.
- Crop diversity induced by intercropping and ecological engineering principles would disorient pests and provide continuous income and employment as well.

White grub, *Leucopholis coneophora*


This subterranean pest feeds on the roots of coconut and cause yellowing of leaves, premature nut fall, delayed flowering, retardation of growth and reduction in yield. Since grubs are hidden in soil, symptom diagnosis is very crucial in the identification of pest damage. Grubs initially feed on organic materials, roots of grasses and intercrops before feeding on the palm roots. Adults emerge from the soil during the month of June. The pest is very severe in certain sandy belts of Kasaragod, Kerala and parts of Karnataka.

Management

- Repeated summer ploughing to expose the immature stages fr predation
- Handpicking of adult beetles during evening of two weeks commencing from the onset of monsoon.
- Application of neem cake in the palms basin @ 5 kg /palm for regeneration of roots.
- Soil application of aqua suspension of entomopathogenic nematode, Steinernemacarpocapsae @ 1.5 billion/ha and need based repeated application

Rugose Spiralling Whitefly *(Aleurodicus rugioperculatus)*

This period could also witness the establishment of the invasive rugose spiralling whitefly (*Aleurodicusrugioperculatus*) in new areas as well as re-emergence in already reported areas. Presence of whitefly colonies on the lower surface of palm leaflets and appearance of black coloured sooty mould deposits on the upper surface of palm leaflets are characteristic visual symptoms of pest attack. In severe cases, advancement in senescence and drying of old leaflets was observed. Leaflets, petioles and nuts were also attacked by the whitefly pest and a wide array of host plants including banana, bird of paradise, Heliconia sp. were also reported.

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

Rugose spiralling whitefly Parasitized pupae

Encarsiaguadeloupae Sooty mould scavenger beetle

improve the health of juvenile and adult palms

- No insecticide should be used as this causes resurgence of the pest and complete kill of the natural aphelinid parasitoid, *Encarsiaguadeloupae*. A pesticide holiday approach is advocated for the build up of the parasitoid.
- Installation of yellow sticky traps and conservatory biological control using *E. guadeloupae* could reduce the pest incidence by 70% and enhance parasitism by 80%.
- Habitat preservation of the sooty mould scavenger beetle, *Leiochrinusnilgirianus* could eat away all the sooty moulds deposited on palm leaflets and cleanse them reviving the photosynthetic efficiency of palms.
- A close scrutiny should be made for the presence of other whiteflies including the nesting whiteflies on coconut system.

Coreid Bug, *Paradasynus rostratus*

Nymphs and adults puncture the meristematic regions of tender buttons (1-3 months old) injecting toxin around the feeding site causing necrosis. Feeding punctures develop into necrotic lesions and these spindle-shaped depressions could be visible when the perianth of shed button is removed. Female flowers are attacked prior to pollination and such flowers get dried and can be seen attached to inflorescence on the crown resulting in production of barren buttons. Most of the infested buttons and tender nuts shed down. Retained nuts on the bunch develop furrows and crinkles on their husks and are malformed. In many cases gummosis can be seen on such

Management

- Crown cleaning to destroy eggs and immature stages of the pest
- Spraying of azadirachtin 300 ppm (Nimbecidene) @ 0.0004% (13 ml / l) reduced the pest incidence at the highest level. Two rounds of azadirachtin spray on young coconut bunches 1-5 months old during May-June and September-October are quite essential for satisfactory control of the pest in the field
- Among the natural enemies, the weaver ant, Oecophyllasmaragdinais found to be the most efficient predator of coreid bug in the field.
- Two egg parasitoids, namely Chrysochalcissaoviceps and Gryonhomeoceri, were identified as potential egg parasitoids. Forty per cent parasitism was observed in the egg mass collected from the field due to these parasitoids.
- Spraying cholrantraniliprole 0.3 ml/litre or lambda cyhalothrin @ 1.0 ml/litre on the pollinated bunches was found effective.

Disease

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 the development of the bud rot disease. Contiguous occurrence of such "favourable days" during rainy seasons determines the development of the disease and the intensity of infection. As Phytophthora diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.

Management

- Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence. For the newly planted seedlings also prophylactic spraying of Bordeaux mixture (1%) can be given to avoid infection. In localities where heavy wind is experienced and leaves of coconut palms got damaged, spraying of Bordeaux mixture (1%) is essential to prevent infection by Phytophthora.
- 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 months as 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.

As envisaged, timely monitoring and prophylactic measures are very critical to safeguard palm health and provide optimum nut yield. Protection is therefore the key strategy to boost up productivity and double farmer's income. ■

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Market Review – June 2019

Domestic Price

Coconut Oil

During June 2019 the price of coconut oil opened at Rs.14400 per quintal at Kochi and Alappuzha market and Rs.15050 per quintal at Kozhikode market. During the month, price of coconut oil at kochi and aleppey markets expressed an overall upward trend.

The price of coconut oil closed at Rs.14500 per quintal at Kochi and Alappuzha market and Rs.15000 per quintal at Kozhikode market with a net gain of Rs.100 per quintal at Kochi and Alappuzha market and a net loss of Rs.50 per quintal at Kozhikode market.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.11533 per quintal, expressed a mixed trend during the month and closed at Rs.11467 per quintal with a net loss of Rs.66 per quintal.

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

	Kochi	Alappuzha	Kozhikode	Kangayam
01.06.2019	14400	14400	15050	11533
09.06.2019	14400	14400	15050	11500
16.06.2019	14500	14500	15150	11600
23.06.2019	14500	14500	15150	11533
30.06.2019	14500	14500	15000	11467

Milling copra

During the month, the price of milling copra opened at Rs.8900 per quintal at Kochi, Rs.8800 per quintal at Alappuzha and Rs.9200 per quintal at Kozhikode market. The price of milling copra at Kochi and Alappuzha market expressed a slight upward trend, whereas the price of copra milling copra at Kozhikode market expressed a slight downward trend during the month.

The prices closed at Rs.9000 at Kochi market and Rs.8900 at Alappuzha market with a net gain of Rs.100 per quintal at Kochi and Alappuzha market. The price of milling copra at Kozhikode market closed at Rs.9200.

At Kangayam market in Tamilnadu, the prices opened at Rs. 8000 per quintal and closed at Rs.8200 per quintal with a net gain of Rs.200 per quintal.

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

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.06.2019	8900	8800	9200	8000
09.06.2019	8900	8800	9200	8000
16.06.2019	9000	8900	9350	8200
23.06.2019	9000	8900	9300	8200
30.06.2019	9000	8900	9200	8200

Edible copra

The price of Rajapur copra at Kozhikode market opened at Rs. 14900 per quintal expressed a downward trend during the month and closed at Rs.11000 per quintal with a net loss of Rs.3900 per quintal.

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

01.06.2019	14900
09.06.2019	14500
16.06.2019	13200
23.06.2019	13000
30.06.2019	11000

Ball copra

The price of ball copra at Tiptur market which opened at Rs.15000 per quintal expressed a mixed trend during the month and closed at Rs.12500 per quintal with a net loss of Rs.2500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)

01.06.2019	15000
09.06.2019	13500
16.06.2019	12500
23.06.2019	13000
30.06.2019	12500

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.10000 per quintal expressed an overall

downward trend during the month. The prices closed at Rs.9600 per quintal with a net loss of Rs.400 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.06.2019	10000
09.06.2019	9800
16.06.2019	9800
23.06.2019	9800
30.06.2019	9600

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.12000 per thousand nuts and closed at the same rate. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.10000 per thousand nuts and ruled at same price throughout the month and closed at Rs.10000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs.17000 and closed at Rs.20500 per thousand nuts.

Weekly price of coconut at major markets (Rs /1000 coconuts)				
	Neduman-gad	Pollachi	Banglore	Mangalore (Grade -1)
01.06.2019	12000	10000	17000	21000
09.06.2019	12000	10000	17000	21000
16.06.2019	12000	10000	18500	20000
23.06.2019	12000	10000	18500	20000
30.06.2019	12000	10000	20500	20000

International price

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
01.06.2019	111	140	140	313
08.06.2019	112	140	159	320
15.06.2019	111	n.q.	159	328
22.06.2019	111	n.q.	140	328
29.06.2019	100	n.q.	139	328
*Pollachi market				

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/ Indone-sia (CIF Europe)	Philip-pines	Indone-sia	Sri lanka	India*
01.06.2019	642	638	639	1,757	1679
08.06.2019	647	620	642	1,531	1675
15.06.2019	651	620	n.q.	1,614	1689
22.06.2019	634	617	n.q.	1,556	1679
29.06.2019	611	623	n.q.	1,699	1670
* Kangayam					

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
01.06.2019	407	389	930	1165
08.06.2019	410	392	930	1165
15.06.2019	409	n.q.	930	1194
22.06.2019	404	n.q.	928	1194
29.06.2019	405	n.q.	928	1194
* Kangayam				