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From the desk of Chairman

Dear Coconut Farmers,

Summer rains have reached in time in major coconut growing states and the farmers are busy with planting coconut seedlings. In order to increase the production and productivity at potential level in traditional states like Kerala, Karnataka and Tamilnadu, replanting or under planting of old and senile palms needs to be done on war footing basis.

The quality of planting material is one of the most important factors for getting sustainable and profitable yield for any crop. In a cross pollinated crop like coconut with long pre bearing period it is of utmost importance. Each farmer while purchasing coconut seedling for planting expects that it should be early bearing and high yielding, short in stature with high content of kernel.

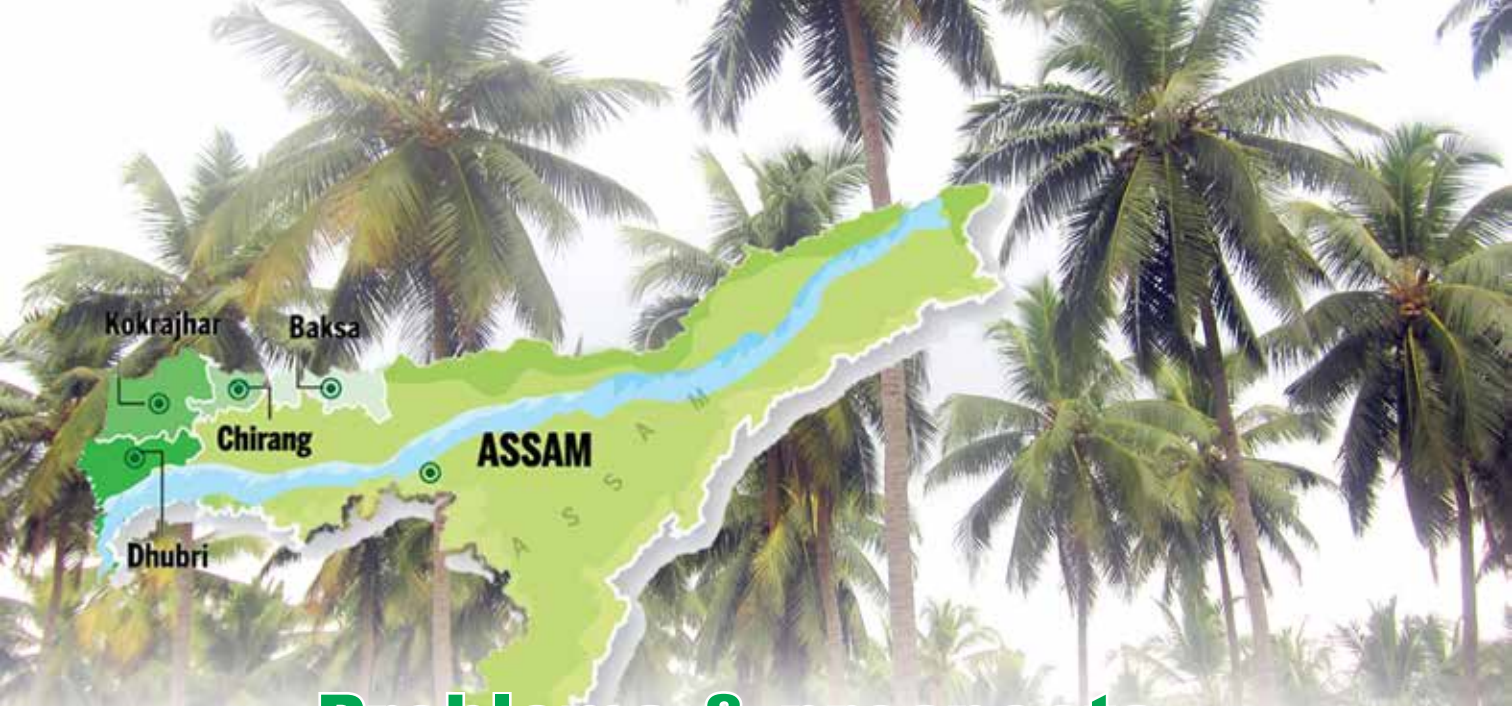
Coconut is a cross pollinated palm which does not breed true making selection of seeds and seedlings more difficult and important. Therefore production of good quality seedlings, selection of seed garden, good mother palms, seed nuts and seedlings based on physical growth parameters are of great importance. The national agency, Coconut Development Board (CDB) is strictly insisting on quality parameters for production and supply of seedlings at its Demonstration cum Seed Production Farms and nurseries supported by CDB in government and private sector.

During this occasion, I request all farmers to ensure the quality of planting material to raise new plantation of coconut in the season. Freedom from any infection must be confirmed before procurement. Such early precautions, after scientific management will enable palms produce desired yield.

With warm regards,

A K Singh

Chairman



Problems & prospects of Coconut in Assam – a review

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Coconut is produced in 92 countries worldwide in around 12.20 million hectares. World production is estimated about 70,000 million nuts with an average yield of 10,345 nuts per ha. India is the leading coconut producing country, having contribution of about 31 per cent of total production with coverage of almost 17.54 per cent of world coconut area. Coconut production continued to be concentrated in three countries namely, Indonesia, Philippines and India having share of about three-fourth of both global area and production. More importantly, India's share in global coconut production is on the rise and the country earns a lot from this commodity.

In India, coconut is widely produced in four southern coastal states viz., Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. These states together cover about 88 per cent of total area and almost 90 per cent of the coconut production in the country. The north eastern states share only 1.50-1.56 per cent of country's coconut area of which Assam has the lion's (about 63 per cent of area and about 77 per cent of production) share (Table 1).

Assam is traditionally rich in horticultural production due to its diverse and unique agro-climatic condition which is conducive for growing wide range of horticultural crops like fruits, vegetables, flowers, spices, nuts, tuber crops and medicinal and aromatic plants. The world citrus belt encompasses Assam within it. Horticultural crops occupy about 20 percent of the cultivated area of Assam (Table 1) and annually produce more than 67 lakh MT of various horticultural products besides nut crops, flowers and medicinal & aromatic plants thus contributing significantly towards food and nutritional security of the state. According to the Directorate of Horticultural and Food Processing, the growth rate of fruits production, spices and vegetables of Assam was 19.18 percent, 6.40 percent and 72.20 percent respectively during the last ten years.

During the fifth plan period, the necessity of accurate statistics on area and production of plantation crops arecanut and coconut was felt for formulation of various agricultural development programmes. Since then the sample survey for estimation of area and production of arecanut & coconut are being conducted annually by Directorate of Economics and Statistics, Assam. In Assam, major coconut producing districts (Table 2)

Table 1: Status of coconut in land allocation : a comparative look in North-East Year : 2013-14

States	Total Geo-graphical Area (000'ha)	Total Culti-vable Area (000'ha)	Total Horticultur-al Area (000'ha)	Coconut Area ('000 ha)	% share in total horticultural crop area	Production (Million nuts)	Productivity (Nuts/ha)
Assam	7843.8	3387	626.0	21.14 (63.27)	3.38	237.49 (77.13)	11234
Nagaland	1657.9	626	74.5	1.45 (4.34)	1.95	16.32 (5.30)	11255
Tripura	1048.6	310	126.2	6.93 (20.74)	6.68	28.41 (9.23)	4100
Arunachal*	8374.3	293	103.7	0.800 (2.39)	0.77	3.84 (1.25)	2667
Meghalaya*	2242.9	1074	113.6	1.050 (3.15)	0.92	5.21 (1.69)	3065
Mizoram	2108.1	445	120.3	0.04 (0.12)	0.03	0.16 (0.05)	4000
Manipur*	2232.7	164	84.1	2.000 (5.99)	2.38	16.47 (5.35)	5067
Total	25508.3	6299	1248.4	33.41	2.68	307.9	9216

*Source: http://www.icarzcu3.gov.in/land.htm *Estimated data of coconut, http://agricoop.nic.in/, http://www.coconutboard.nic.in*
Figures in parentheses indicate corresponding share in Total of North-East

are Nagoan, Sonitpur, Golaghat (all in central Assam covering about 30 per cent of state area), Barpeta, Kamrup, Nalbari, Baksa, Bongaigaon (Table 2)(all in Western Assam covering about 30 per cent of state area). But it deserves to mention that almost all the districts of Assam have ample potential for coconut cultivation which is to be tapped.

A review of progress of coconut in Assam state since 1985-86 has been undertaken and presented in Table 3. It can be observed that coconut area, production and productivity have increased about 164.25 per cent, 337.37 per cent and 65.52 per cent respectively in 2014-15 since 1985-86. Thus, Simple Annual Growth Rates (SAGR) in these growth parameters happens to be 5.48 per cent, 11.25 per cent and 2.18 for area, production and productivity respectively. The state also experienced negative growth in all these parameters but during different time phases. For example, acreage under coconut slumped since 2000-01 till 2010-11, production slumped since 1995-96 to 2000-01 and again since 2005-06 to 20100-11, productivity slumped since 1990-91 till 2000-01 and again since 2005-06 till 2010-11. Thus, instability in all these growth parameters of coconut is noticed in the state.

Having identified the prima facie growth scenario in the data series, the trend is analysed here. The entire data series has been divided into two sub-periods : Period I – 1985-86 to 1999-2000, Period II – 2000-01 to 2014-15 and growth behaviors were identified by employing exponential form of trend equation $Qt = aebt$ where, Qt represents output (area / production / productivity), b represents coefficient on time and 'a' represents intercept term. The exponential form of trend equation has been employed for its inherent advantage of obtaining Compound Annual Growth Rate (CAGR) straightway

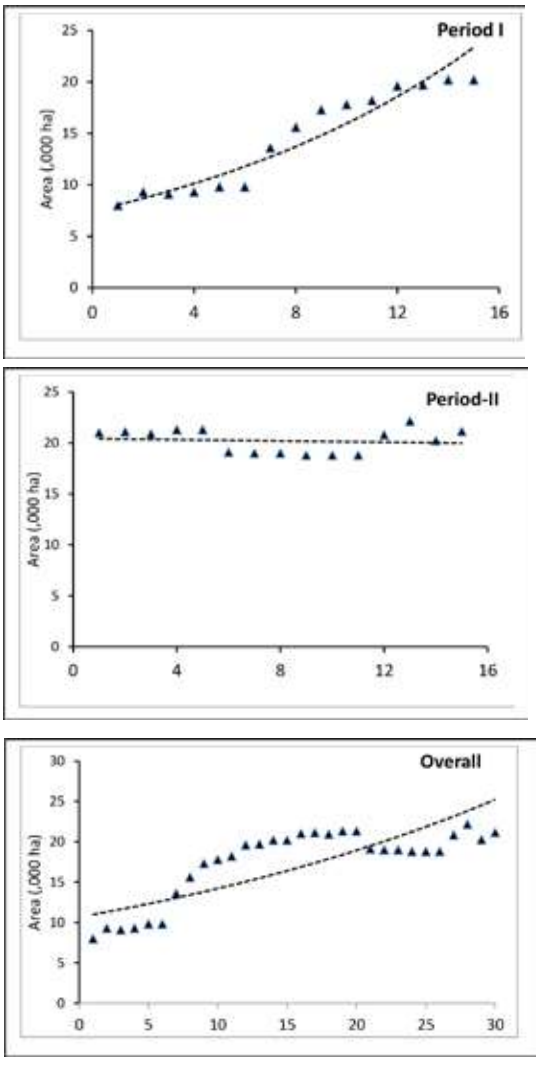

Figure 1 : Trend in area under coconut in Assam over the years

Table 2 : Major coconut producing districts in Assam							
District	Total Geo-graphical Area (000'ha)	Total Cultivable Area (000'ha)	Total Horti-cultural Area (000'ha)	Coconut Area ('000 ha)	% share in total horticultural crop area	Production (Million nuts)	Productivity (Nuts/ha)
Nagaon	411.03	291.339	14.259	3.35 (15.82)	23.46	15.117 (10.30)	4520
Barpeta	264.51	263.797	10.001	1.93 (9.13)	19.30	24.996 (17.03)	12952
Sonitpur	532.298	253.46	14.208	1.882 (8.90)	13.24	13.801 (9.40)	7334
Kamrup R	308.684	181.901	14.2	1.253 (5.93)	8.82	12.45 (8.48)	9937
Golaghat	354.07	180.097	12.35	1.053 (4.98)	8.53	11.878 (8.09)	11281
Nalbari	100.483	112.689	6.05	1.38 (6.53)	22.81	9.945 (6.78)	7207
Baksa	196.108	128.119	5.834	1.15 (5.43)	19.71	7.984 (5.44)	6943
Bongaigaon	151.999	108.785	4.909	0.63 (2.98)	12.83	6.444 (4.39)	10229
Udalguri	167.393	159.814	5.436	0.714 (3.38)	13.13	4.957 (3.38)	6943
Goalpara	184.262	128.83	8.206	0.575 (2.72)	7.00	4.758 (3.24)	8275
T o t a l	7850.005	4099.462	209.118	21.141	10.10	146.776	6943
Source: Directorate of Economics and Statistics (http://ecostatassam.nic.in/), www.coconutboard.gov.in							

from the equation (Boyce, 1987). Obtained analytical result is presented in Table 4 and Fig. 1-3.

By scrutinizing the figures (Fig. 1-3) and the Table 4, it can be construed that both area and production of coconut in the state progressed remarkably well during the first period i.e., 1985-86 to 1999-2000. During this period the concerned area progressed significantly at CAGR 7.6 per cent and production progressed significantly at 6.9 per cent and correspondingly the trend line progressed successively upward (Fig 1,2). In the second period (i.e., 2000-01 to 2014-15) the coconut area shows a discernible negative CAGR (-0.2 per cent) though production and productivity grows non significantly positive. Overall (over thirty years), CAGR, though significantly positive (for area 2.9 per

Table 3 : Coconut in Assam : a journey over the years						
Year	Area (,000 ha)	% change	Pro-duction (million nuts)	% change	Pro-duc-tivity (Nuts/ ha)	% change
1985-86	8.0	-	54.3	-	6787	-
1990-91	9.8	22.50	78.9	45.30	8051	18.62
1995-96	18.2	85.71	140.3	77.82	7709	-4.25
2000-01	21.0	15.38	136.0	-3.06	6476	-15.99
2005-06	19.1	-9.05	204.9	50.66	10728	65.66
2010-11	18.8	-1.57	147.1	-22.96	7824	-21.73
2014-15	21.1	12.45	237.5	50.44	11238	33.79
Source : www.coconutboard.nic.in						

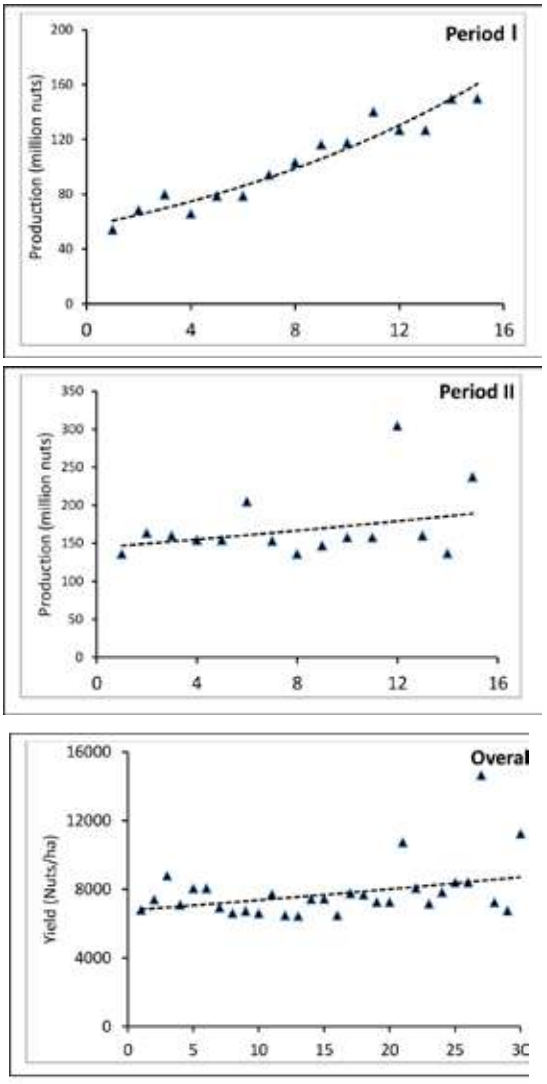

Figure 2 : Trend in coconut Production in Assam over the years

Table 4 : Time series analysis (period I, period II, overall : area, production, productivity)

Growth parameters	Period I (1985-86 to 1999-2000)			Period II (2000-01 to 2014-15)			Overall (1985-86 to 2014-15)		
	Trend Equation	R2	CAGR	Trend Equation	R2	CAGR	Trend Equation	R2	CAGR
Area	$Y = 7.46e^{0.076\,t}$	0.92	7.60**	$Y = 20.44e^{-0.002t}$	0.014	-0.20^{NS}	$Y = 10.67e^{0.029t}$	0.63	2.90**
Production	$Y = 56.63e^{0.069t}$	0.93	6.90**	$Y = 144.16^{e0.018t}$	0.13	1.80^{NS}	$Y = 72.20^{e0.037t}$	0.73	3.71**
Yield	$Y = 7586e^{-0.006t}$	0.10	-0.60NS	$Y = 7051e^{0.0196t}$	0.16	1.96^{NS}	$Y = 6767e^{0.008t}$	0.17	0.84^{NS}

*Significant at 5% level; ** Significant at 1% level; NS : Non Significant

cent, for production 3.71 per cent, for productivity 0.84 per cent) are rather sluggish in nature.

There may be several technical, institutional and social problems for this slow growth. However, following major factors can be cited for the slow growth of coconut cultivation in Assam :

- Non-availability of standard planting material : CDB DSP farm Abhayapuri serve as the only source for quality planting material in the State as well as entire north eastern states. CPCRI and KVKs produces few coconut seedlings. Though the performance of West Coast tall, Hybrid D X T and Kamrupa released by Assam Agricultural University are excellent, but are not available in large scale for planting.
- Non-adoption of scientific management practices by the farmers : The farmers are not following the scientific method for cultivation. Mostly, they are not in the habit of using fertilizer for coconut trees. Neither they are aware about crop improvement, crop protection, production and cropping system resulting in immature nut fall in the region. Boron deficiency is one of the major problems reported in Assam but the farmers are not much aware about that.
- Difficulty in mechanized farming : Fragmented land holding pattern, scattered plantation, and the small size of plots make it really difficult for mechanized farming which is highly essential for cost as well as time effectively.
- Absence of Coconut-based industry : Lack of coconut based industrial units reduces the farmers intrest to adopt large scale cultivation.
- Incidence of Diseases-Pest and non adoption of management practices: Assam indicated that the incidence of stem bleeding ranged between 1-16% in different areas under districts of Kamrup, Nagaon, Morigaon and Darrang. The incidence of crown choke was estimated to be maximum 20% in some areas of Kamrup. Similarly, preliminary survey carried out in different areas of Kamrup, Nagaon, Morigaon, Goalpara and Udalguri districts of Assam revealed that districts like Morigaon and Nagaon had maximum incidence of Eriophyid mite attack while Morigaon district has the highest mite incidence (35.75%) and intensity (76.96%) followed by Nagaon (Acharya et al,) .
- **Sociological impediments :** There is a common belief amongst people that fat content is high in mature coconut flesh, so though tasty, it increases fat in the body. Therefore, this nut is to be avoided in every day cooking. Hence coconut is not a preffered cooking medium for daily cooking. So, this notion of people regarding coconut is definitely an impediment for coconut development in North East. Mature nut is used for some special purposes in Assam, like preparation of sweet dishes like laddu & pitha during Bihu festival and Durga puja. Also, it is used while offering prayer to gods and goddesses. Tender coconut water is generally consumed by the people when they feel sick or think that consuming this water will give them vigour.

In order to overcome these bottlenecks the following steps can be undertaken.

- **Cluster District Approach :** Cluster of districts are to be formed with potential or focused districts where implementation of all relevant schemes, specially, area expansion and coconut nurseries has to be concentrated during the coming four or five years. Depending on the performance of schemes, popularity of coconut cultivation, adoption of technologies and the number of districts under the cluster may be planned.
- **Promotion of Private Coconut Nursery Units:** Private coconut nurseries, regional nurseries and nucleus seed gardens are to be promoted on large scale through advertisement, publicity etc. so that in the near future

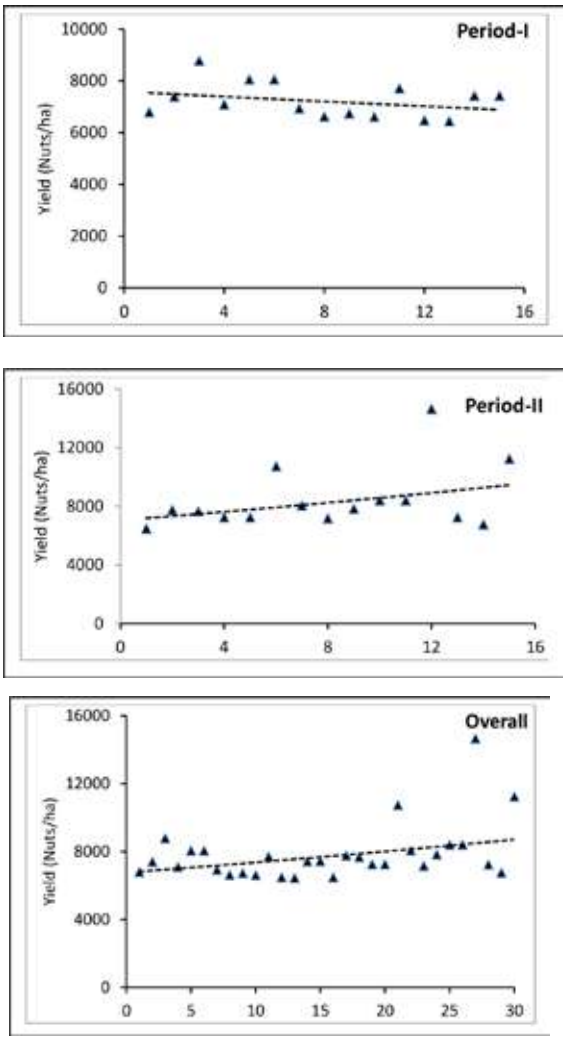

Figure 3 : Trend in coconut yield in Assam over the years

there will be no dearth of quality planting materials of the tall & dwarf varieties.

● **Encouragement & Promotion of FPO :** Due priority is to be given to the formation of Farmer Producer Organisation so that CDB schemes can be implemented through them successfully. But awareness and capacity building is very much needed to strengthen the societies so that they can take up schemes like AEP (Area Expansion Programme), LODP (Laying of Demonstration Plot), OMU (Organic Manure Unit), Nurseries etc. & skill development training programmes like FOCT (Friends of Coconut Tree), Handicraft, convenience food etc.

Facilitating Market Linkage : Market backward and forward linkages should be established very strongly. Direct marketing by the farmers in the wholesale/retail markets is to be facilitated. FPOs can play a major role in this sector like the FPOs formed under SFAC in the NVUIC project of Government of India.

Coconut-based Multi cropping System : Successful models of coconut based multiple cropping system are to be developed for NE India so that steady income generation from coconut orchards are to be ensured. Trials can be done in farmers field as well as in the farm with the crops like cocoa, nutmeg, banana, spices, pineapple, lemon etc. Best model of intercropping, based on income generation and healthy plant nutrition is to be developed.

Incubation Centre : One incubation centre may be developed in collaboration with Indian Institute of Crop Processing Technology, Government of India. Entrepreneurs may hire machineries for production of coconut products like cookies, biscuits, dessicated coconut powder, milk cream, virgin coconut oil etc.

● **Wide scale mass communication :** Publicity of CDB schemes, benefits of cultivation, value addition etc. are to be done through TV, Radio, Newspapers, Magazines etc. Printing and distribution of leaflets/ booklets in all NE languages like Assamese, Mizo, Nagamese, Bengali, Khasi etc may also be undertaken.

Abstract

Coconut, a plantation crop, plays an important role in the agricultural economy of Assam, a North-Eastern state in India. North-eastern states share about 1.56 per cent of country's coconut area in which Assam supplied the major bulk (about 77 per cent). But the state lags substantially behind in all the growth parameters viz. coconut area, production and productivity. Time series analysis for thirty years (1985-86 to 2014-15) in Assam shows a distinctly reverse picture in growth in two sub-periods (Period I : 1985-86 to 1999-2000 & Period II : 2000-01 to 2014-15). Spectacular growth has been noticed in sub-period I (CAGR for area & production were 7.6 & 6.9 per cent per annum respectively) which slumped drastically in period-II (CAGR for area & production was -0.20 per cent per annum and 2.80 per cent per annum respectively). Lack of coconut-based industrial units, rather subsistence nature of farming, lack of awareness etc. are thought to be responsible for this tardy growth especially in the 21st century. The cluster district approach, promotion of coconut nurseries for quality planting material, private seed producing entrepreneurs, encouraging coconut-based multi-cropping system and especially in non-traditional areas are some of the measures for rather faster growth of coconut economy in the state.

References : *Gobinda Ch Acharya*, Ranjana Chakrabarty and Himadri Rabha, Central Plantation Crops Research Institute, Kahikuchi, Assam*

Boyce, J.K (1987). Agrarian Impasse in Bengal. Oxford University Press. http://www.icarzcu3.gov.in/land.htm, http://agricoop.nic.in/, http://www.coconutboard.nic.in, http://ecostatassam.nic.in/ ■

Quality standards for coconut seedling production

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Quality planting material is the most important input for getting sustainable and optimum yield from any crop. In coconut, quality should start from the mother garden level. In the absence of commercially vegetative propagation techniques only seed propagation is possible in coconut. The desirable qualities like early bearing, yield, high copra content & oil and short stature are controlled by genes present in 32 chromosomes in each cell of coconut palm which is transferred from generation to generation through seeds. Hence quality of seeds is highly correlated with mother garden characters. Further, as coconut is cross pollinated, the palm do not breed true, making the selection of seeds and seedlings more difficult and important. Therefore for production of quality seeds and seedlings, selection of good mother gardens and seed nuts is of great importance. Quality standards for selection of mother palms and seed nuts and seedlings recommended for coconut are given below

1. Field standards (Quality at mother palm level)
Identify high yielding blocks. Selection of parent palms from high yielding blocks is important to obtain good seednuts for making optimum use of genetic potential of coconut.

Quality criteria for selection of parent palms.

- Select bearing palms between 15-45 years.
- Stout, sturdy and straight stem and closely set leaf scars.
- Short leaves in a spherical orientation on the crown.
- The crown should comprise of 25-30 fully opened fronds with bunches of nuts at all stages of maturity.
- Short and stout petioles capable of providing a solid support to the bunches.
- Short and strong bunch stalks.
- Bunches of medium sized nut in sufficient numbers.
- Avoid palms affected by pest and diseases for collection of seeds.

2. Seed Standards

- Germination - *>80%*
- Purity - *>98%*
- Fruit weight (g) - *>400g-(Dwarf) >600g (Talls)*
- Nut water - *Present*
- Maturity - *10-11 months (Dwarfs) / 11 – 12 months (Talls)*
- Pest and disease incidence - *Nil*
- Validity period - *Validity period for germination for coconut nursery is three months after sowing of seednuts.*

In the West Coast region seed nuts can be collected during the period January – April and can be sown in June in the nursery where as in the East coast region seed nuts are sown during October - November.

Harvested seed nuts are stored in shade to prevent drying of nut water till their husks become completely dry. Seed nuts of the tall variety can be stored for two months after harvest whereas the seed nuts of dwarfs should be sown within 15 days of harvest. Only fully matured nuts should be harvested for seed purpose. Discard nuts having irregular shape and size. All immature and empty nuts should be rejected before delivery of seednuts to nursery.

3. Coconut nursery standards

- The land should be flat or with low gradient.
- Soil should be sandy or sandy loam and well drained.
- The site should have sufficient sunlight, scattered shade and source of water.
- Seed beds should be 15-25 cms above the ground level.
- Spacing between nut should be 15 cms and between rows it should be 25 cms.
- Mulching the nursery with coconut leaves or coirpith.
- Regular watering in nursery during dry weather.
- Weeding once or twice in a month.

4. Seedling Standards

- Age of seedling - *10 to 12 months*
- Number of leaves - *6 and above with short petiole.*
- Girth at collar region - *Dwarfs - >8cm, Hybrids/talls - >10cm*
- Height -*Dwarfs - >80cm*, *Hybrids/talls - >100cm*
- Petiole colour - *Dwarfs- should exhibit petiole colour of parent, Hybrids- Green/Brown/intermediate shades of parents*
- Disease/pest incidence - *Absent*

Good quality seedlings which germinated early are to be selected in the nursery for field planting. The seedling vigour which can be identified based on the quality parameters stated above can be selected. Early splitting of leaves is another character preferred for

selecting good seedlings. In general recovery of good seedlings will be 60 – 65 percent of total seed nuts sown as coconut is a cross pollinated crop. In a well managed nursey, rejection of seedlings should be kept at following levels.

Non germinated - *8-10%*
Late germinated - *10%*
Low quality - *12-15%*
Total - *30-35 %*

Selection of mother garden, mother palms, seeds and seedlings are important steps in production of quality coconut seedlings to ensure higher yield. Seeds/ seedlings with good quality based on the parameters described above should be selected through a rigorous selection. Selection of fully matured nut is very important in coconut seedling production as the germination and quality of planting material has got a direct bearing on maturity. It is necessary to select consistently yielding mother palms from a block of mother garden for seed procurement. The expectations of each farmer while purchasing seedlings for planting will be that it should be early bearing, high yielding, give high copra content and oil, shall be of short stature etc. If poor quality planting materials are used for planting, the performance of the palm will not satisfy the expectation of the farmer and cause considerable loss of time and money to the farmer. Hence while purchasing seedlings especially from private nurseries the quality parameters as stated above shall be insisted. Wide publicity should be given through various media by the extension officers involved in coconut sector so as to ensure supply of good quality seedlings to the farming community. ■

Collaborative Network on Coconut R & D under ICAR-AICRP on Palms

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Introduction

The All India Coordinated Research Project (ICAR-AICRP) on Palms with its headquarter at ICAR-CPCRI, Kasaragod coordinates research on development of location specific technologies to improve the productivity of coconut, arecanut, oil palm, palmyrah and sulphi palm in different agro climatic regions. Fifteen centres are conducting research on coconut regarding genetic resource management, crop improvement, crop production and crop protection.

History of AICRP on Palms

All India Coordinated Coconut and Arecanut Improvement Project was sanctioned by the ICAR in 1970 and the project started functioning with 12 centers across eight states in 1972. Oil palm and Palmyrah palm were included as mandate crops and the project was renamed as All India Coordinated Research Project on Palms in 1986. During the course of time different centers were added in different agro-climatic regions of the country to address location specific problems related to mandate crops. Currently the project is implemented in 29 centres including fifteen centres on coconut, eight on oil palm, four on arecanut and two on palmyrah palm.

List of AICRP on Palms Centres conducting research on coconut in India Research on coconut is being carried out in its 15 centers located in 12 states and one union territory covering 12 SAUs/SHUs and 3 ICAR institutes.			
State	**Centre/Location**	**Area of Research**	**University/ Institutions**
Andhra Pradesh	Horticultural Research Station, Ambajipeta, East Godavari District- 533 214 Phone: 08856-244436/243711	Crop Improvement, Production & Protection	Dr.Y.S.R Horticultural University, West Godavari District, Andhra Pradesh- 534 101
Andaman and Nicobar	Central Island Agricultural Research Institute, Port Blair- 744 101 Phone : 03192-250436	Crop Improvement & Production	Indian Council of Agricultural Research
Assam	Horticultural Research Station, Kahikuchi, Kamrup District, Guwahati- 781 017 Phone : 0361-2840232	Crop Improvement & Production	Assam Agricultural University, Jorhat, Assam-785 013
Bihar	Bihar Agricultural College, Sabour, Bhagalpur District, Bihar-813 210 Phone : 0641-2451001	Crop Improvement & Production	Bihar Agricultural University, Sabour, Bhagalpur, Bihar - 813 210
Chhattisgarh	Saheed Gundadhoor College of Agriculture & Research Station, Kumharawand Farm, Jagdalpur, Chhattisgarh- 494 005 Phone : 07782-229360	Crop Improvement & Production	Indira Gandhi Krishi Vishwavidyalaya, Raipur - 492 012
Gujarat	ASPEE College of Horticulture & Forestry, Navsari Agricultural University, Navsari, Gujarat- 396 450 Phone : 02637-282144	Crop Improvement & Production	Navsari Agricultural University, Navsari, Gujarat- 396 450
Goa	Central Coastal Agricultural Research Institute, Ela, Old Goa Dist., Goa - 403 402 Phone : 0832-2285448	Crop Improvement & Production	Indian Council of Agricultural Research
Karnataka	Horticultural Research Station, Arsikere, Hassan District- 573 103 Phone: 08174-291565/291711	Crop Improvement, Production & Protection	University of Horticultural Sciences, Navanagar, Bagalkot, Karnataka - 587 102
Kerala	Central Plantation Crops Research Institute, Kasaragod - 671 124 Phone : 04994-232733	Crop Production	Indian Council of Agricultural Research
	Regional Agricultural Research Station, Pilicode P.O., Kasaragod - 670 353 Phone:0467-2260450	Crop Improvement	Kerala Agricultural University, P.O. KAU, Vellanikkara, Thrissur, Kerala - 680 656
Maharashtra	Regional Coconut Research Station, Bhatye, Ratnagiri District- 421 612 Phone : 02352-255077	Crop Improvement, Production & Protection	Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri District- 415 712
Odisha	Department of Horticulture, (OUAT), Bhubaneswar, Odisha - 751 003 Phone : 0674-2397463	Crop Improvement & Production	Orissa University of Agriculture & Technology, Bhubaneswar, Odisha -751 003
Tamil Nadu	Coconut Research Station, Aliyarnagar, Coimbatore District- 642 101 Phone: 04253-288722/288662	Crop Improvement, Production & Protection	Tamil Nadu Agricultural University, Coimbatore - 641 003
	Coconut Research Station, Veppankulam, Thanjavur District- 614 906 Phone: 04373-260205/202534	Crop Improvement, Production & Protection	
West Bengal	Directorate of Research, P.O. Kalyani, Nadia District, West Bengal- 741 235 Phone :033-25827574	Crop Improvement & Production	Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal- 741 252

Varieties/ Hybrids released by ICAR-AICRP on Palms			
Sl. No.	**Variety/Hybrid**	**Parents**	**Recommended for**
Varieties (Tall)			
1	Pratap	Banawali	Konkan region of Maharashtra
2	Kamrupa	Assam Green Tall	Assam
3	ALR (CN) 1	Arasampatti local	Tamil Nadu
4	Kalyani Coconut -1	Jamaican Tall	West Bengal
5	Kera Keralam	West Coast Tall	Kerala, Tamil Nadu and West Bengal
6	Kera Bastar	Fiji Tall	Coastal region of Andhra Pradesh, Tamil Nadu and Konkan region of Maharashtra and Bastar region of Chhattisgarh
7	Kalpa Dhenu	IND 006 (AGT)	Kerala, Karnataka, Maharashtra, Tamil Nadu and Andaman& Nicobar Island
8	Kalpa Pratibha	IND 016 (CCT)	Kerala, Karnataka, Maharashtra Tamil Nadu and Coastal region of Andhra Pradesh
9	Kalpa Mitra	IND 022 (JVT)	Kerala, Karnataka, Maharashtra, Tamil Nadu and West Bengal
10	Kalpatharu	Tiptur Tall	Karnataka, Tamil Nadu and Kerala
11	Kalpa Shatabdi	San Ramon	Tamil Nadu, Karnataka and Kerala
Varieties (Dwarf)			
12	Gauthami Ganga	Gangabondam	Coastal region of Andhra Pradesh
13	Kalpa Jyothi	IND 058(MYD)	Kerala, Karnataka and Assam
14	Kalpa Surya	IND 048(MOD)	Kerala, Karnataka and Tamil Nadu
Hybrids			
15	Konkan Bhatye Coconut Hybrid -1	GBGD x ECT	Maharashtra
16	Kalpa Samrudhi	MYD x WCT	Kerala and Assam
17	Kalpa Sreshta	MYD x TPT	Kerala and Karnataka
18	Vasista Ganga	GBGD x PHOT	Andhra Pradesh and Karnataka
19	Godavari Ganga	ECT x GBGD	Andhra Pradesh
20	Kalpa Ganga	GBGD x FJT	Karnataka
21	VPM -5/VHC 4	LCT x CCNT	Tamil Nadu

Achievements of AICRP on Palms in coconut research

Crop improvement

• Germplasm collection- A total of 112 local ecotypes of coconut was collected from different agro-climatic zones and are being evaluated for their performance.

• Elite mother palms have been identified in different agro-climatic regions for collecting seed nuts and further quality seedling production.

• Nucleus seed gardens for the released coconut varieties/hybrids were established at the respective State Coconut Research Stations to meet the demand of seedling requirement.

• The following location-specific coconut varieties/hybrids have been released for commercial cultivation.

Crop Production

Nutrient management

• Integrated nutrient management packages were recommended for the cultivation of coconut in different regions.

• Tamil Nadu: 1000:250:1000g NPK /palm/ year

• Assam: 500:500:2000 g NPK/palm/year

• WB: 1000:500:1000 g NPK/palm/year

• Konkan : 1000:500:2000 g NPK/palm/year

• Karnataka: 1000:250:1000g NPK /palm/year

Water management:

Drip irrigation: Region specific drip irrigation schedule was recommended for improved water use efficiency

Region	Months	Quantity of water (lit/palm/day)
Western region of Tamil Nadu	February-May	65
	January, August - September	55
	June-July, October – December	45
Eastern region of Tamil Nadu	March-September	80
	October – February	50
Maiden tracts of Karnataka	February-May	65-75
	Oct-January	40-50
Konkan region	February to May	40
	October to January	30

Drip fertigation: Improvement in water and nutrient use efficiency and reduced cost of production of coconut through location-specific fertigation schedules.

• Application of nutrients through drip irrigation in eight splits from October to May was found to be optimum.

• In Aliyarnagar and Arsikere centres, recommended dose of fertilizer (RDF) through drip fertigation recorded significantly higher yield which was on par with 50 and 75% of fertilizer application through drip fertigation. Hence, 50% RDF can be recommended for drip fertigation in coconut.

• In Aliyarnagar, Veppankulam, Mondouri and Kasaragod Centres, fertigation of 50% (RDF) was found to be on par with fertigation of 75% RDF and soil application of 100 per cent RDF. Hence, fertigation of 50% RDF can be recommended.

• In Ambajipeta, Ratnagiri, Arsikere Centres, 75% RDF through fertigation recorded significantly higher yield compared to soil application of 100% RDF and on par with 100% RDF through fertigation. Hence, drip fertigation of 75% RDF can be recommended.

Multi species cropping system

Gladiolus as intercrop

Turmeric as intercrop

Location specific coconut based cropping system with different crops:

Sl. No.	Region	Component crops
1	Tamil Nadu	• Coconut + banana + turmeric + EFY + pine-apple + tapioca + bhendi • Coconut + black pepper + banana + elephant foot yam + coriander • Coconut + galanga + lemon grass + patchouli • Coconut + aloe + galangal + tulsi • Coconut + marigold + gomphrena + chry-santhemum
2	West Bengal	• Coconut + black pepper + pineapple • Coconut + sarpagandha + aswagandha + arrowroot • Coconut + gladiolus + tuberose + gerbera
3	Odisha	• Coconut + banana + tube rose (in young coconut garden) • Coconut + stevia + artensia
4	Chhattis-garh	• Coconut + black pepper + carnation + chrysanthemum • Coconut + stevia + amahaldi + sarpagandha + tikhur + patchouli
5	Asom	• Coconut + black pepper + turmeric • Coconut + pipali + patchouli + citronella + sarpagandha • Coconut + gerbera + tuberose + gladiolus
6	Maharash-tra	• Coconut + turmeric + banana + pineapple + tapioca • Coconut + sathavari + adulsa + arrow root + lemon grass + citronella • Coconut + lily + jasmine (Jasminum multiflo-rum) + heliconia
7	Karnataka	• Coconut+ banana + drumstick + french bean+ ladies finger + red gram • Coconut + banana (High water requirement) • Coconut + annual drumstick (Medium water requirement) • Coconut + red gram (low water requirement) • Coconut + lemon grass + garden rue + tulsi + kalmegh + arrow root + makoi • Coconut + chrysanthemum + crossandra + jasmine (J. multiflorum)
8	Gujarat	• Coconut + turmeric + amorphophallus
9	Andhra Pradesh	• Coconut + palmarosa + mango ginger + patchouli + citronella

Coconut based farming systems: Coconut based cropping systems under integrated nutrient management developed at different AICRP Centres showed higher productivity and income than monocrop of coconut

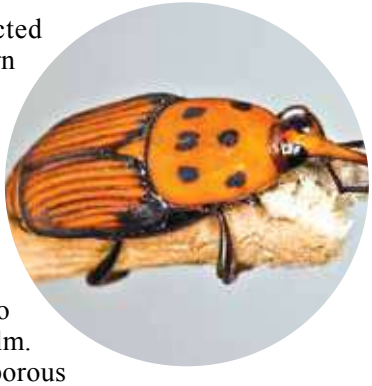
Crop Protection

Pest management

Rhinoceros beetle: An IPM strategy involving removal and burning of dead coconut palms, collection

and destruction of various bio stages of the beetle from manure pits, examining the crowns of the palm frequently and hooking out the adults, placing three naphthalene balls or chlorantraniliprole (Ferterra) 5g + 25g soil / palm at the base of the inner most leaves once in 45 days, application of Metarhizium anisopliae @ 5 x 1011 spores / m3 on manure heaps, setting up of Rhinolure traps @ one per 2 ha, resulted in gradual decrease in the level of damage caused by rhinoceros beetle on leaf, spathe and spindle. Nanoporous matrix CPCRI lure was found to be effective against rhinoceros beetle at Aliyarnagar, Ambajipeta and Ratnagiri centres.

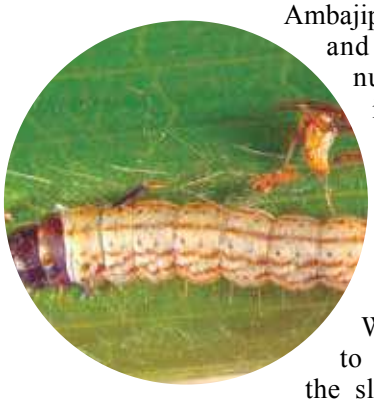
Red palm weevil:



Chisel out affected trunk region and burn the infected portion. Smear the wounded portion with coal tar. After cleaning the trunk, fill the tunnelled portion of trunk with cement and sand mixture to give strength to the palm. Installation of Nanoporous matrix CPCRI lure along with Kairamone blend was found to be effective against red palm weevil at Amabjipeta and Ratnagiri centres.

Black headed caterpillar:

Braconid parasitoid, Bracon brevicornis and Bethylid parasitoid Goniozus nephantidis were mass multiplied at the AICRP centres in the respective states and supplied to farmers in large numbers (Aliyarnagar- 8,06,800, Ambajipeta-32,30,000 and Ratnagiri- 92,000 numbers) to control incidence and spread of the caterpillar.



Slug caterpillar

Light traps @ three traps/ha with 200 W incandescent bulb 1 ½' above + Water pan was found to be effective against the slug caterpillar, Darna nararia. Installation of 4-5 light traps/ha along with spraying of Bt formulations (1g/l) successfully controlled pest population in Ramenahally and Bommenahally villages of Karnataka during a recent outbreak of slug caterpillar.

Eriophyid mite

Eriophyid mite damage based on mean damage grade index was found to be the lowest in palms treated with azadirachtin 1% (root feeding) (10 ml + 10 ml water)+ IPM+INM practices when compared to the untreated control garden and garden with IPM and INM practice alone.

Disease Management

Leaf blight (Lasiodiplodia theobromae):

Combined application of talc-based powder formulation of Pseudomonas fluorescens to soil (50 g/ palm/year) and neem cake (5 kg/palm/year) followed by root feeding of 100 % culture filtrate of P. fluorescens

Mass rearing of parasitoid in laboratory

Releasing of parasitoids against black headed caterpillar

Garden infested by slug caterpillar

Larval stage of D. nararia

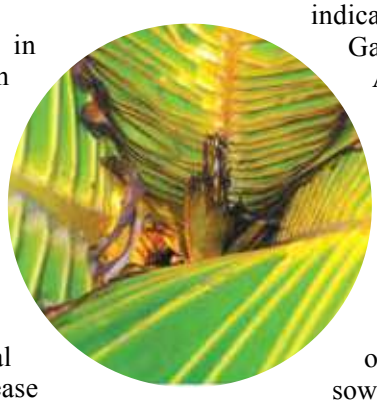
Adult moths of D. nararia trapped in light trap

Leaf blight affected palm

Basal stem rot affected palm

Application of T. viridae + neem

at half yearly intervals is effective in managing the disease. Soil application of microbial consortia consisting of P. fluorescens, Bacillus subtilis and Trichoderma viride @ 300g along with FYM 5 kg/palm at quarterly interval was found to be effective in reducing the leaf blight disease incidence.



Root feeding of Tebuconazole @ 2ml + 100 ml water at quarterly interval reported maximum reduction in disease severity of leaf blight disease under field conditions at Puliyankandi village in Coimbatore district and Gomangalampudur village in Tirupur district of Tamil Nadu.

Bud rot

Application of talc formulation of P. fluorescens @ 10g was effective when compared to T. viride @ 10g and application of culture filtrates of 100% and 50% of both the bio agents.

Basal stem rot

Bengal gram and red gram were identified as efficient indicator plants for basal stem rot pathogen Ganoderma lucidum at Ambajipeta and Arsikere centres.

Integrated disease management practices include application of recommended dose of fertilizers to the coconut palms every year, drip or basin method of irrigation, frequent irrigation especially during summer months, raising in situ green manure crops like sunhemp and sesbania to increase soil organic matter and antagonistic microflora, sowing of indicator plants in the tree basins and observation for symptom development there by early detection of the disease, uprooting and destruction of diseased and dead palms along with the roots, application of 50 g of T. viride in combination of 5 kg of neem cake to the diseased palms once in every year and application of the above said mixture at the rate of 1kg to all the healthy palms in the diseased garden as a prophylactic measure.

Hexaconazole 5% SC at 0.1% was found effective against the pathogen under in vitro conditions in Ambajipeta and Arsikere. ■

Shell Charcoal

Jyothy K Nair, Food Processing Engineer
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Shell Charcoal is obtained by burning the shell of fully matured coconuts with a limited supply of air so that they do not burn away to ash but are only carbonized. The manufacture of shell charcoal from the coconut shell has become a very important economic and commercial activity. Furthermore, coconut shell charcoal, which was relatively minor product in the past, has now developed into a general commercial commodity due to its intrinsic value as a raw material for the manufacture of activated carbon. Coconut shell charcoal shall be of the following two types: Coconut shell charcoal – pieces and Coconut shell charcoal - granulated

Simple Mud Pits/ Brick Lined Pits

It is basically a simple process, consisting of burning the shells in a limited supply of air, so that the shells are only carbonized and not burnt to ash. The tricky part of this operation is to set the optimum conditions for carbonization to the correct degree. The charcoal manufactured by this method is of inferior quality, containing lot of impurities. Moreover emission of a lot of smoke and flue gases during the process causes atmospheric pollution.

Process (Drum Method)

M.S. Drum kiln is used for carbonization of shells. The drum consists of three sets of six 1" dia holes provided at its bottom, middle and upper layers and a lid. A detachable chimney is provided which is installed on the lid after closing the drum. The manufacture of charcoal requires optimum carbonization of raw shells in a limited supply of air so that there is neither unburnt shell nor ash due to complete combustion. The steel drum is filled with raw shells after placing temporarily a four inch diameter wooden pole in the centre of the drum. The wooden pole is then removed, leaving a hollow space in the centre which allows the flow of smoke during carbonization. To start carbonization, a piece of burning rag is dropped to the bottom of the drum through the hollow space in the centre. When the fire is well underway, the lid with the chimney is placed into position and the upper and the middle sets of holes are closed. Carbonization which starts at the bottom progresses as it goes up as well as radially from the hollow space. When carbonization is complete in a particular zone, a persistent glow can be seen in all the six holes of a set. When the bottom most set of holes indicate this situation, the middle set of holes is opened and the bottom set closed. The stoppage of air flowing into the bottom region avoids over-carbonization in that region. The progressive carbonization results in reduction in volume of contents and therefore more shells are added from the top. When the middle region is

carbonized well, the top set of holes is opened while the middle set is now closed. A further addition of raw shells is done to fill the volume reduction to maximise capacity for burning. When the top region is well carbonized, the top set of holes is also closed, resulting in complete stoppage of air inflow to the drum. The drum is then cooled for about eight hours after which the product is ready for discharge.

Gasifier Technology

It is a new technology adopted by many of the companies for the production of shell charcoal. In this method the coconut shells are dumped into a gasifier and heated at a temperature of 800ºC or more than that. The heat generated during the production of shell charcoal is separated out with the help of a cyclone separator and is used for purposes wherever heat can be utilized which ultimately help the entrepreneur to earn more profit.

Granulated Charcoal

The charcoal prepared is then pulverized to form granules and the granules are then used for the processing of activated carbon.

Packaging and Marking

Unless otherwise specified, coconut shell charcoal shall be packed in sacks suitable for safe transportation. They shall be of uniform size containing 50kg of the material. Each container shall carry a tag/label clearly marked with all details.

Charcoal Briquettes

The shell charcoal powder is the waste product obtained during the processing of charcoal. The powder is binded with the help of binding materials and moulded in the form of briquettes using moulding machine.

Yield of the product

In India, the average output has been found to be 35 Kg of charcoal from 1000 whole shells or about 30,000 whole shells yield 1 tonne of charcoal.

Properties of Shell Charcoal

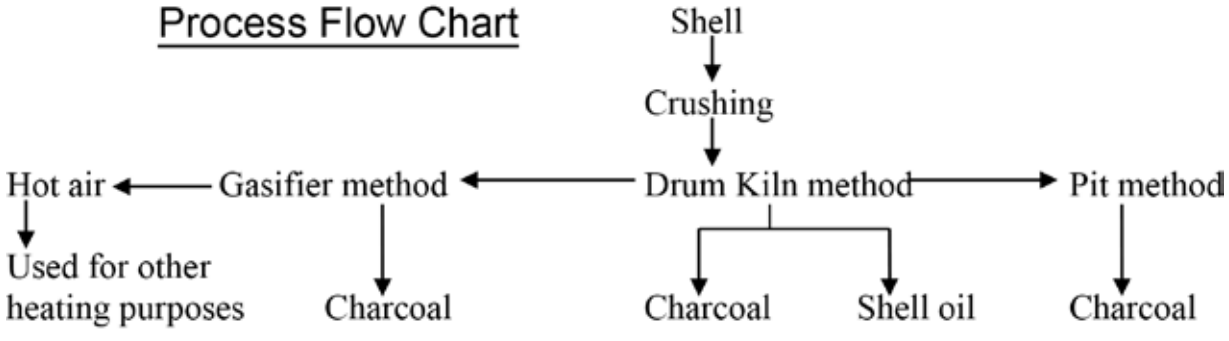
Good coconut shell charcoal is uniformly dark and snaps with a clean shining fracture and produces a metallic sound, when dropped on hard ground.

Underburnt shells do not give a metallic sound and a clean fracture, while the overburnt ones are friable and the surface of the fracture sounds dull when dropped and easily crumbles. Coconut shell charcoal contains the highest percentage of fixed carbons of all the lignaceous charcoals. The average composition of good charcoal is moisture 6.24%, volatile 5.46 %, ash 0.54% and fixed carbon 87.76%. The quality standards for shell charcoal as per Asian and Pacific Coconut Community (APCC) are as follows:

Moisture	Less than 10%
Ash	Not more than 2%
Volatile matter	Not more than 15%
Fixed carbon	Not more than 75%
Foreign matter	Not more than 0.5%
Colour	Black
Size	Not more than 5%, shall pass a 0.63 cm mesh sieve.

Uses of Shell Charcoal

The charcoal has a high adsorption capacity for gases and colouring matter and can therefore be used



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Impact of humic acid on growth and vigour of coconut seedlings

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Introduction

Coconut plays a very significant role in Asian economy and is grown throughout tropical world. With good farm management practices farmers can achieve maximum yield and profit from coconut. Success of coconut plantation establishment starts with the production of good quality and vigorous planting material. Kotob (2009) reported that humic acid (HA) application enhances the seedling emergence, plant growth and mitigate the harmful effect of salinity. Coconut Development Board at its DSP Farm Mandya, Karnataka during the year 2016-17 conducted an experiment for finding out the effects of different levels of humic acid (HA) on the growth and vigour of coconut seedlings. Improving soil conditions and establishing the equilibrium among plant nutrients are also important for soil productivity and plant production. For this purpose, organic matter and similar materials were applied in soil, increasing agricultural production by improving soil physical, chemical and biological properties of soil. Among various amendments humic acid increased availability of plant nutrients in soil and crop production by improving soil physical, chemical and microbiological properties.

The study was undertaken to determine the effects of different levels of humic acid on growth and vigour of coconut seedlings. The coconut seedlings were raised in beds and after germination of seedlings, the different levels of humic acid concentration viz. 10%, 20% and 30% were applied to the soil twice at 60 days intervel. Experimental layout was a completely randomized design with three replications. Growth parameters such as plant height, collar girth, number of leaves and leaf width of coconut seedlings were recorded.

Application of humic acid had positive effects on growth parameters of coconut seedlings. The results are in line with findings of Fagbenro and Agboola (1993), who had reported that HA was beneficial to the growth of teak seedlings.

Significant variations were observed between the treatments in respect to plant height. 30% HA treatment showed taller plant height followed by 20% HA compared to 10% HA and shorter plant height was recorded in control. The thickest collar girth was observed in 30% HA and 20% HA treatments and they significantly differed from 10% HA and control. Ertan Yildirim (2007) observed that 20 ml/l concentration of HA sprays could be successfully used to obtain better growth and yield in Tomato. There were no significant differences between the treatments in the number of

leaves and leaf width.

The effects of HA application is safe, effective and it can be easily adopted by farmers to improve the seedling quality. Therefore, HA may put to good use as natural fertilizer in sustainable and ecological agriculture system.

The result of the study indicates that 30% humic acid applied to the soil shows better growth and vigour of coconut seedlings.

Table1. The effects of humic acid levels on coconut seedling growth

Humic Acid Levels	Plant Height (cm)	Girth (cm)	No. of Leaves (cm)	Leaf Width (cm)
10%	130.93 b	11.60 b	4.67 a	20.13 a
20%	133.13 b	12. 47 a	4.87 a	19.90 a
30%	138.73 a	12.87 a	5.27 a	21.40 a
Control	125.47d	11.40 b	4.73 a	19.93 a
C.D at 5%	3.06	0.6	NS	NS

Different alphabets shows significance difference at p <0.05

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as a refining agent both as a deodorizer and as a decolourizer. The shell charcoal also finds way to laundries, smitheries etc. Well powdered shell charcoal finds limited use as a dentifrice. The charcoal is used by goldsmiths in melting gold and silver and for other metal works. The commercial value of shell charcoal lies in its use as the primary raw material for the production of activated carbon. It also finds very good demand as an industrial fuel to substitute furnace oil.

Capital Investment required for setting up of shell charcoal manufacturing unit

Components	Total Project Cost			
	1 Tonne	3 Tonne	6 Tonne	9 Tonne
	(` in lakhs)			
Land	Own/ Lease	Own/ Lease	Own/ Lease	Own/ Lease
Plant & Equipments	10.00	15.00	25.00	40.00
Building & Civil works	6.00	8.00	10.00	12.00
Electrical installation	0.50	0.75	1.25	2.00
Preliminary & Pre op. expenses	0.16	0.23	0.36	0.64
Working Capital margin	2.00	6.00	12.00	18.50
TOTAL	18.66	29.98	48.61	73.14

Export Potential of Shell Charcoal

Export of coconut shell charcoal from India during the year 2016 – 17 is about 30,000 MT which is around 300% higher than that of the export during previous year (7,565.85 MT). Coconut shell charcoal (ITC HS Code 44029010) is eligible for 5% incentive under Merchandise Export from India Scheme (MEIS). The international demand for coconut shell charcoal is expected to increase in the coming years.

CDB Scheme for Promotion of Coconut Industries

Coconut Development Board under Technology Mission on Coconut extends financial assistance to the limit of 25% of the eligible project cost limited to Rs. 50 lakhs per project. For SC/ST women entrepreneurs, financial assistance is extended upto 33.3% of the total project cost limited to Rs. 50 lakhs per project. ■

Health mix incorporated with Coconut flour

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Abstract

Health mix was prepared by varying the proportions of coconut flour and the most acceptable product was selected after organoleptic evaluation. Quality characteristics, nutrient composition and shelf life of the health mixes were determined and compared with the standard. BV3 containing 30% coconut flour had obtained maximum scores for all the sensory attributes like texture, taste and overall acceptability and was selected to evaluate the shelf life. The mean overall acceptability scores were 8.3±0.45 and 8.6±0.48 on 0th day and 3.8±0.74 and 4.1±0.53 on the 90th day for standard and BV3 respectively. The product was desirable up to 90 days of storage. The number of microbial colonies was within the permissible range. The energy, carbohydrate, protein and fat content of BV3 were lower than the standard, however the fibre content (14.88g) was much greater.

Introduction

Coconut dietary fiber is particularly important as it is reported to produce high amount of butyric acid in stomach, which helps in inhibiting tumor formation. Coconut flour incorporated foods show low glycemic index, which is good for proper control and management of diabetes mellitus and in the maintenance of weight. It can reduce serum total cholesterol, LDL cholesterol and triglycerides in moderately raised serum cholesterol levels of human (Trinidad, 2001). Coconut flour plays a role in controlling cholesterol and sugar levels in blood and prevention of colon cancer. Studies revealed that consumption of high fiber coconut flour increases faecal bulk (Arancon, 2009).

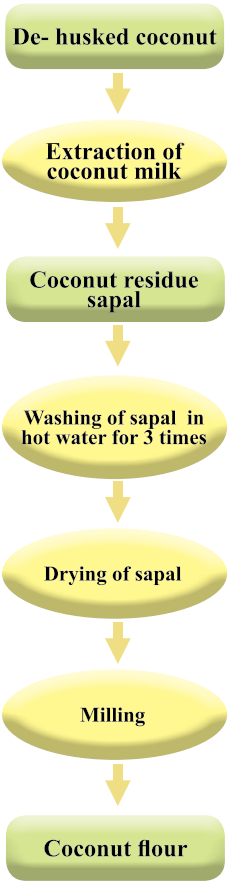
In the present study, health mixes were prepared by varying the proportions of coconut flour, from which the most acceptable product was selected after organoleptic evaluation for shelf life studies. This value addition will improve the health of the consumer as indigenous food products are used for the formulation.

Materials and methods

Ethical Clearance

Ethical clearance was obtained for Human studies from PSG Institute of Medical Sciences and Research, Coimbatore.

Fig.1 Preparation of Coconut Flour



Ingredients for Health Mix

Ingredients namely millets like Ragi, Bajra and Jowar, pulses like roasted Bengal gram and sprouted green gram, nuts and oil seeds like peanuts, almonds and cashew nuts were selected. Sugar and cardamom were selected for flavor and taste. The procured samples were cleaned, sun dried, roasted and finally ground in a mill.

Preparation of Coconut Flour

Coconut flour was prepared from coconut residue called sapal which is the meal usually discarded after milk extraction (Trinidad, 2002). The preparation of coconut flour is explained in figure-1. The flour obtained was stored at room temperature and used for product formulation.

The ingredients (Table-1) were mixed together and packed in HDPE packages, sealed, labeled and stored at room temperature.

Preparation of Porridge

Porridge was prepared by dissolving 50 g formulated health mixes with 150 ml boiling water and cooked for five minutes in a low flame and served warm. Sugar was added for taste.

Organoleptic Evaluation

Organoleptic evaluation is an important part of the process of developing new food products. It provides information pertaining to improving the quality of a food product and it is essential to assure the maintenance of high quality standard on a continuing basis. An organoleptic change includes the change in color, flavor, taste and consistency.

Organoleptic characteristics of the porridge were evaluated by 20 panel members for different sensory attributes like color, taste, texture, flavor and overall acceptability using nine point hedonic scale to select the most acceptable variant. The panel members were selected on the basis of their health, cooperation, willingness, availability and knowledge of sensory analysis as also ability to discriminate the various criteria for sensory evaluation.

Nutrient Calculation

Nutrients namely Carbohydrate, Protein, Fat, Fiber and Energy were calculated using Nutritive values for Indian foods (ICMR, 2012).

Shelf Life Study of the Formulated Health Mixes

Contamination of foods by mold or bacteria is common, hence their presence in the finished product is considered unfit for consumption (Ranganna, 1986). Shelf life can be defined as a finite length of time after production and packaging during which the food product retains a required level of quality under well-defined storage conditions. This required quality level allows the product to be acceptable for consumption (Maria, 2012).

Table-1 Formulation of Health Mixes

Ingredients	Quantity (g / 100g)					
	Stan-dard	BV1	BV2	BV3	BV4	BV5
Coconut flour	-	10	20	30	40	50
Ragi	20	20	20	15	10	10
Bajra	20	20	20	15	10	10
Jowar	20	20	20	15	10	10
Roasted Bengal Gram	15	10	5	7.5	10	5
Sprouted Green gram	15	10	5	7.5	10	5
Peanuts	5	5	5	5	5	5
Almond	2.5	2.5	2.5	2.5	2.5	2.5
Cashew nut	2.5	2.5	2.5	2.5	2.5	2.5
Cardamom	1	1	1	1	1	1
BV1, BV2, BV3, BV4, BV5 - Variants						

The formulated health mixes were packed in HDPE packages and stored at room temperature for three months. The samples were drawn at regular intervals of seven days and 15 days for microbial analysis and organoleptic evaluation respectively to find out the shelf life of the products.

Microbial Analysis of the Formulated Products (FSSAI Standards, 2012)

The formulated food products were subjected to microbial analysis every seven days and the food homogenate was prepared by dissolving 1g of powdered sample mixed with distilled water and was mixed vigorously. From this, the sample dilutions were prepared. For each dilution a fresh pipette was used. Pipetted 1 ml of food homogenate into tube containing 9 ml of distilled water, from the first dilution transferred 1 ml to second tube and so on till seventh dilution.

About 0.1 ml of 5^{th} and 6^{th} dilution was plated on sterile nutrient agar plates. The plates were incubated

at 37°C for 24 h in inverted position. Following the incubation, all the colonies present on the plates were counted. Total number of colonies present in 1 g of the sample was calculated using the formula

$$N = \frac{(\sum c)}{((N1+0.1N2)D)}$$

∑ C is the sum of colonies counted on all the dishes retained
N1 is the number of dishes retained in the first dilution
N2 is the number of dishes retained in the second dilution
D is the dilution factor corresponding to first dilution

The colonies were counted and tabulated, from which the shelf life of the products was estimated.

Organoleptic Evaluation

Organoleptic characteristics were measured every 15th day till 90 days of storage as mentioned earlier.

Statistical Analysis

The obtained results were interpreted using statistical tools. Tools such as general linear model, t- test, ANOVA and post hoc were performed.

Results and Discussion

Nutrient Content of Health Mixes

Functional properties are physicochemical properties which give information on how a particular ingredient (protein and carbohydrate) will have on a food system (Neelam, 2005). Nutrients namely carbohydrate, protein, fat, fibre and energy of the prepared health mixes were calculated (NIN, ICMR). The energy, carbohydrate, protein and fat content of the prepared health mix (Table II) were lower than the standard, however the fibre content (14.88g) of BV3 was much greater. This is because BV3 was prepared with coconut flour. According to Trinidad et al. (2006), coconut flour contains 600g of total fiber/ kg with 560g of insoluble and 40 g of soluble fiber/ kg. The glycemic index of coconut flour supplemented foods decreases with increasing levels of dietary fiber from coconut flour. Therefore this health mix can be recommended for diabetics.

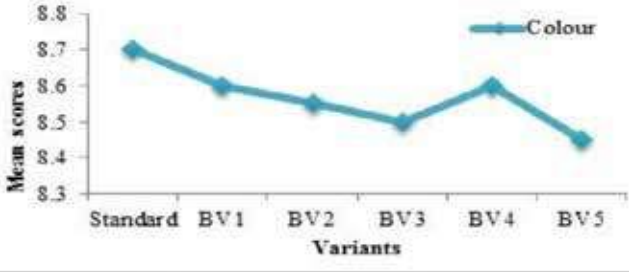


Fig.2 Mean Scores for Colour

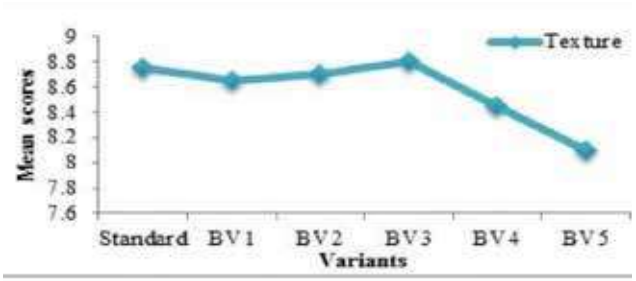


Fig.3 Mean Scores for Texture

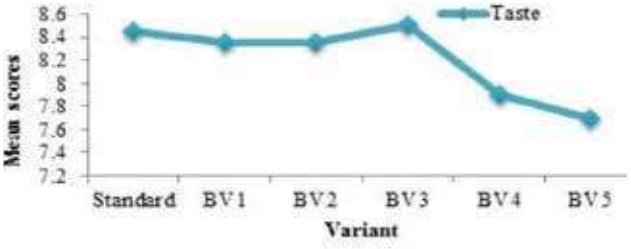


Fig.4 Mean Scores for Taste

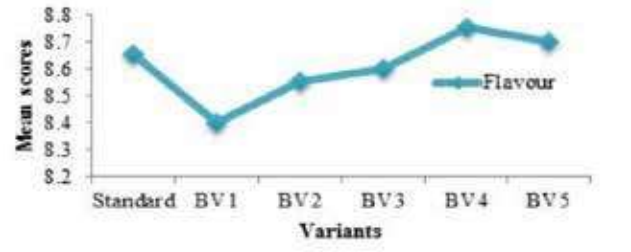


Fig.5 Mean Scores for Flavour

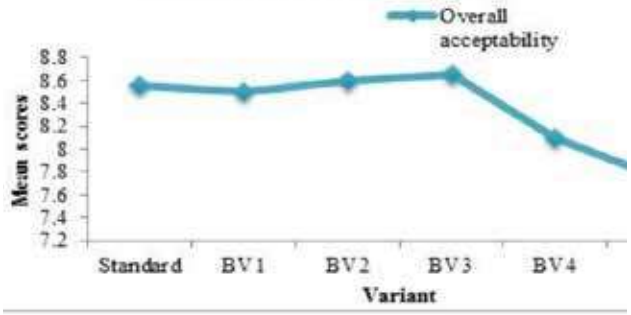


Fig.6 Mean Scores for overall

Table. II Nutrient Content of Health Mixes

Health Mix	Nutrients/100g				
	Energy (kcal)	Carbohy-drate (g)	Protein (g)	Fat (g)	Fiber (g)
Standard	378.0	65.0	17.0	3.0	6.0
BV3	343.21	60.77	16.91	9.69	14.88

Organoleptic Evaluation Scores of Heath Mix Prepared using Coconut Flour

The mean scores of organoleptic evaluation for porridge prepared with health mix and standard are shown in Figures 2, 3, 4, 5 and 6.

It is observed (Fig 2) that the standard had obtained maximum score for colour (8.7±0.45) followed by BV4 (8.6±0.48). Mean colour score of variants ranged between 8.4 ±0.66 and 8.6±0.48. The colour was off white for standard, but for the variants it was very light brown, light brown, yellow, brown and dark brown, corresponding to the increasing order of addition of coconut flour. Although the colour was darker in the variants they had a good eye appeal.

The scores for texture of porridge ranged from 8.1±0.62 to 8.8±0.4. Most of the panel members opined that BV4 was moderately acceptable and BV5 was not acceptable. The high fiber content of coconut flour has interfered with the textural properties of porridge. The characteristic smoothness was not observed in BV4 and BV5 which had 40 and 50% coconut flour incorporation. The results reveal that the mean score obtained for texture of BV3 was the maximum (8.8±0.4).

Same scores (Fig. 4) were obtained for taste by BV1 and BV2. The mean score for standard was 8.4±0.66 while BV3 had obtained maximum score (8.5±0.59) for taste which was greater than standard porridge. The

Table-III Microbial Load of Formulated Health Mix	
Days	Number of CFU/gm
0	> 1 CFU/ gm
7	> 1 CFU/ gm
14	> 1 CFU/ gm
21	6 CFU/ gm
28	1 ×102 CFU/gm
35	1.8×102 CFU/gm
42	0.4×103 CFU/gm
49	2.2×103 CFU/gm
56	4.9×103 CFU/gm
63	6.8×103 CFU/gm
70	8.2×103 CFU/gm
77	1.1×104CFU/gm
84	1.4×104 CFU/gm
91	1.7×104 CFU/gm

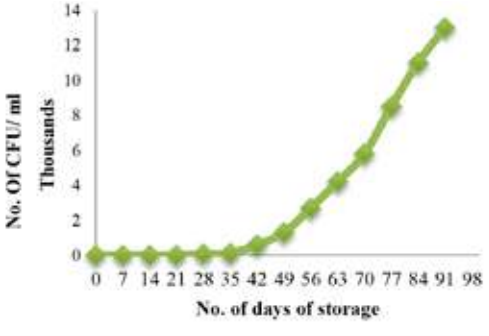


Figure.7 Number of colonies / g of sample on storage intervals

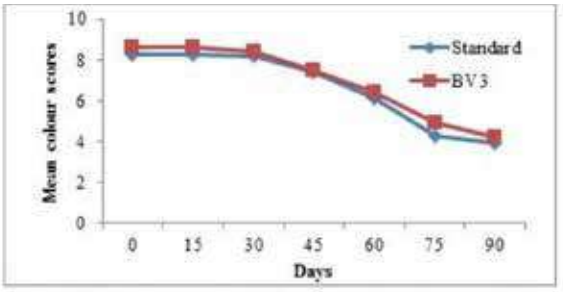


Fig.8 Mean Scores for Colour of Standard and BV3

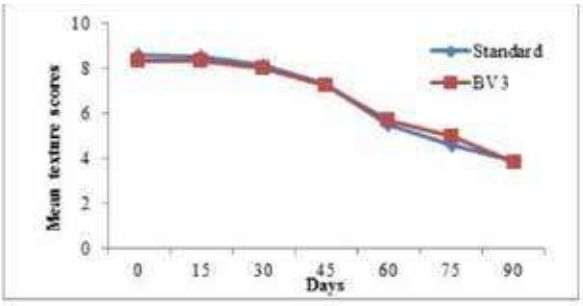
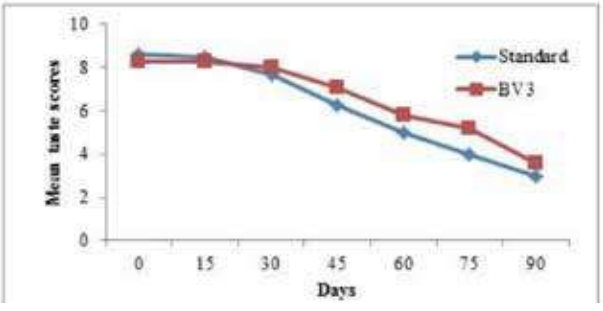


Fig.9 Mean Scores for Texture of Standard and BV3



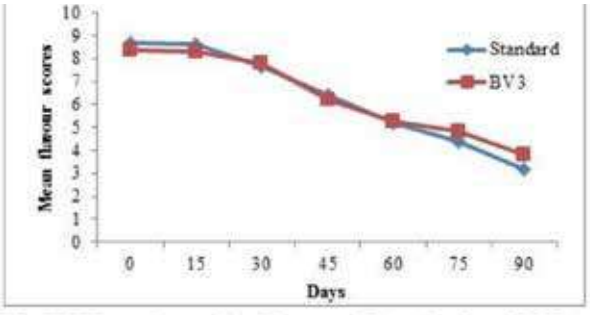
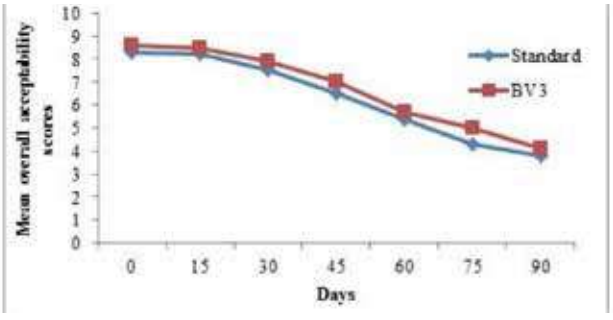


Fig. 11 Mean Scores for Flavour of Standard and BV3



mean scores for taste decreased as the quantity of coconut flour increased. This is because coconut flour is rich in fiber and has an insipid taste thus necessitating extra amount of sugar to be added.

The mean scores (Fig.5) obtained for flavor of the porridge increased with each successive increase in incorporation of the coconut flour. BV4 had a strong coconut flavor and had obtained the maximum score (8.7±0.43). The mean flavor scores of variants ranged between 8.4±0.48 and 8.7±0.43 as against 8.65±0.47 for standard porridge.

From Fig. 6 it is seen that the overall acceptability of BV3 was the maximum. BV1 and BV2 were evaluated as acceptable and BV4 and BV5 were found to be mildly unacceptable. The mean overall acceptability score of porridge prepared with coconut flour ranged between 8.1±0.53 and 8.6±0.47. The mean score obtained for overall acceptability of BV3 was found to be higher (8.6±0.47) than standard (8.5±0.58).

The results of one way ANOVA showed that there was a significant difference observed between groups for texture, taste and overall acceptability while it was not significant for colour and flavor.

BV3 containing 30% coconut flour had obtained maximum scores for all the sensory attributes like texture, taste and overall acceptability and was therefore selected to evaluate the shelf life and to determine the cost of the product.

Shelf Life Study of Standard and BV3

Shelf life is defined as the maximum time for which a food product can be stored under specific environmental conditions without any appreciable deterioration in quality and acceptability. Environmental factors affecting food stability include humidity, oxygen, toxic vapours, physical contamination, light and the time temperature history of the package (Khanna, 1982). Shelf life testing is a standard practice used to estimate the quality and stability of a given food during its storage. The formulated health mix and the standard were tested for microbial load every 7 days, and organoleptic evaluation was carried out at an interval of every 15 days up to 90th day of storage.

Microbial Load

The results of microbial load (Fig.7 and Table-III) revealed that the growth of microorganisms till 77th day was within the permissible limit according to BIS standards (IS 11536:2006), which was below 1.0×104 CFU / g. The results also depicted that till 21st day of storage there were very few visible colonies, which can be attributed to the proper packaging and handling. After the 21st day of storage, there was a steady increase in the microbial load up to 90 days, yet the number of colonies were within the permissible range. However, results of organoleptic evaluation indicated a decrease in the scores Therefore the shelf life studies were carried out till 90 days of storage. Further storage of the mix increased the colony count making the product unfit for consumption.

Sensory Evaluation

The mean scores for colour (Fig 8,9,10,11,12) of the BV3 porridge was higher at the beginning of the shelf life study and upto 30th day. From 45th day the mean scores reduced to a greater extent and was 4.2±0.4 on the 90th day. The scores had decreased by more than 50% on the 90th day in both standard and BV3. A significant difference in colour between standard and BV3 was observed on storage. Similar results were observed in the mean score for flavor.

On 0th day, the standard had obtained a slightly greater mean score (8.6±0.48) for taste compared to BV3 (8.3±0.64). The scores of BV3 were the same on the 0th and 15th day. Thereafter the scores steadily decreased and was 3.6±0.8 on 90th day. Likewise the mean scores for standard also declined steadily and was as low as 3.0±0.89 on the 90th day. The decline was sharp between 30th and 45th day in standard, and between 45th and 60th day, and 75th and 90th day in BV3, however the difference was not statistically significant.

Storage of the health mix containing coconut flour has affected the flavor of the products. The gradual decrease in the mean scores for flavor was observed from 15th day of storage and the score was least on the 90th day of storage. The decrease in scores was marginal up to 45th day and thereafter it started decreasing to a greater extent, and a sharp decline between 30th and 45th day, and between 45th and 60th day was observed. Statistical analysis showed a significant difference in flavor between standard and BV3 on storage.

The mean overall acceptability scores were 8.3±0.45 and 8.6±0.48 for standard and BV3 respectively on 0th day. Here again the scores reduced on storage in both, and it was 3.8±0.74 and 4.1±0.53 in standard and BV3 respectively. It is also clear that the scores had reduced by nearly two-thirds on the 90th day compared to 0th day in both standard and BV3, and the difference was statistically significant. The organoleptic scores of BV3 was acceptable and the panel members did not report any adverse comments about the health mix porridge even on the 90th day..

Cost Calculation

The cost of the standard is Rs.380/ kg whereas that of BV3 is Rs.500/ kg. This increase in cost of BV3 is because of the high production cost of coconut flour. However, from the stand point of health and nutrition, the formulated health mix is far ahead than the standard health mix due to its high fiber and low digestible carbohydrate content. Its application as a therapeutic food holds high value and the health mix can be marketed as a health food. Regular consumption of the formulated health mix prevents/ delays the onset of lifestyle diseases such as obesity, diabetes mellitus and cardio vascular diseases.

Conclusion

The developed health mix is a good source of fiber and low in digestible carbohydrate besides it is a gluten free flour. This helps to maintain the blood glucose level and can be recommended for diabetics. As the coconut is an indigenous food of our country and also has numerous health benefits it can replace cereals like oats (which are not grown in India) and recommended for therapeutic purposes. The coconut flour incorporated health mix can be promoted as a therapeutic alternative to the commercial ones which may not be from natural food source. Since it is also gluten free flour, it can be recommended for individuals with gluten allergy. The formulated health mix can be focused towards the niche market as it satisfies the specific needs of the particular section of people namely diabetics, cardio vascular disease patients and obese individuals. ■

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Kerala leads in coconut farming and production

As per the latest statistics on coconut published by the Ministry of Agriculture & Farmers Welfare, Government of India, the state of Kerala leads in coconut farming and production. Chhattisgarh is the leading state in coconut productivity with 16508 nuts per ha. Andhra Pradesh, Gujarat, Tamilnadu and West Bengal are other states which follow Chhattisgarh in coconut productivity. Kerala is producing 7429.39 million nuts annually. Tamilnadu, Karnataka and Andhra Pradesh are the other states that follow Kerala in coconut production.

Area and production of coconut

STATE	Area "000"Ha	% Share	Production Million nuts	% Share	Productivity (Nuts/Ha)
Kerala	770.62	36.90	7429.39	33.51	9641
Tamil Nadu	459.74	22.01	6171.06	27.84	13423
Karnataka	526.38	25.20	5128.84	23.14	9744
Andhra Pradesh	103.95	4.98	1427.46	6.44	13732
West Bengal	29.51	1.41	373.58	1.69	12658
Odisha	50.91	2.44	328.38	1.48	6451
Gujarat	22.81	1.09	312.68	1.41	13706
Maharashtra	27.75	1.33	271.24	1.22	9775
Bihar	14.90	0.71	141.38	0.64	9489
Assam	19.73	0.94	132.59	0.60	6720
Chhattisgarh	1.85	0.09	30.54	0.14	16508
Tripura	7.20	0.34	29.51	0.13	4097
Nagaland	0.33	0.02	2.67	0.01	8091
Others	52.80	2.53	388.13	1.75	7351
All India	2088.47	100.00	22167.45	100.00	10614

Source : Horticulture Division, Department of Agriculture, Co-operation & farmers Welfare, Government of India.

Mechanization to reduce human drudgery in coconut production

A C Mathew, M R Manikantan and P Chowdappa,
Central Plantation Research Institute, Kasaragod

The greatest challenge coconut farmers are facing is climbing coconut tree for collecting tender nut, mature nuts and for other plant protection operations. Though the Joseph model of coconut climbing machine is gaining popularity, yet climbing the tree for harvesting would be prohibitively costly considering the stagnant price and productivity of coconut palm. Therefore, developing a mechanised device to harvest coconut from ground is the need of the hour. Invariably this should be focal point of researchers. Coconut de-shelling and de-husking are other two operations that require further mechanization. Though, a few prototypes of coconut de-shelling and de-husking machineries are either available or are in the pipeline, manual labour could not be avoided totally in these operations. There is a need for developing appropriate processing techniques and machinery suitable for community level processing of value added products like VCO, coconut chips, desiccated coconut, coconut milk, coconut milk powder etc.

The coconut palm is mainly grown in ecologically sensitive areas such as coastal belts, hilly areas and areas with high rainfall and humidity. Undertaking farm operations in these terrains is cumbersome. Moreover coconut is a tall tree and hence, coconut harvesting, crown cleaning and other operations involve skilled labourers. Non-availability of skilled labourers in addition to the fluctuating prices is the major challenge in coconut cultivation. Therefore, it is envisaged that the future of coconut industry lies in its mechanization. Through the concerted efforts of research over the years, various unit operations in pre and post harvest processing for coconut have been mechanized. Further, mechanization in coconut has gained popularity among farmers for its multi-dimensional benefits such as reduction of operational costs and human drudgery, timeliness of operation, increased labour productivity and efficiency. There also exists a huge scope for coconut based agribusiness in India with reference to processing and value-added products.

Telescopic Sprayer

Anti Buckling Device

Mechanization in coconut

Telescopic Sprayer

The telescopic sprayer comprises of two co-axial pipes of ultra-light weight (0.5 kg/metre length), which can be used to spray up to a height of 12.5 m. The pipe height can be locked at any desired level above 6 m. Marginal farmers could attach a rocker sprayer whereas in large gardens a power sprayer could be used. The telescopic pipe assembly developed by CPCRI is very much useful if the garden is of uniform size. They are lightweight and durable.

Anti Buckling Device

A serious problem often faced by coconut farmers is the buckling of heavy bunches. Partial severing of the stalk from the trunk is known as buckling. A large number of nuts in the bunch and/or big sized nuts, long and less sturdy peduncle, wider angle between the leaf and the inflorescence and weak leaf petiole are some of the causes for buckling of bunches. To prevent the coconut bunches from buckling, a mechanical support has been developed which consists of a trunk-clamp, support-clamps and telescopic support-rods. The harvester developed by CPCRI comprises of two co-axial pipes of ultra-light weight (0.5 kg/m), which can be used to harvest up to a height of 12.5 m (40 ft) from the ground. The pipe height can be locked at any desired level above 6.25 m (20 ft). On the top end of pipe, a specially designed knife is fitted using nuts and bolts. The harvesting knife could be fabricated by local craftsman.

Coconut Climbing Devices

Various types of climbing devices like tractor operated, self propelled, manually operated and some robotic type (electronic) devices have been developed and tested for harvesting coconut by both the government and private sector. Amongst the manual types, one model was developed by a farmer (Joseph model), another by TNAU (TNAU Model) and the third by CPCRI. Of all these the manual device, paddling type model developed by an innovative farmer Joseph model) is the only machine commercially available and used by professional climbers,

Chemberi Joseph Model

Chemberi Joseph Model

Joseph model has got mainly two assemblies of similar construction. The steel rope wires of both top and bottom assembly needs to be looped with the tree and locked. The user then climb on to the machine by placing one foot each on both the assemblies holding the handles provided. Standing on one assembly the user lifts the other assembly to loosen the steel rope and raise it by hand. After attaining a comfortable height, he pushes back the assembly with foot so that it gets tightened to the tree. The user has to co-ordinate these two assemblies simultaneously by using hands and legs to climb on coconut tree. This model costs 21,500/- only which is easily affordable by even small farmers. It does not require much skill and with 2 to 3 days initial training both boys and girls can easily climb coconut tree.

TNAU Model of coconut climbing machine

While imparting training and commercializing the Joseph model of climbing machine, the only limitation felt by the climbers is the safety of climbers, in case of machine failure or from accidental falling. Recently, CPCRI has developed a safety attachment to this model of climbing machine. The safety attachment is independent of the climbing machine and gives fool-proof safety to the climber from falling.

Coconut De-Husking Machine

TNAU Model

This was developed by Tamil Nadu Agricultural University (TNAU). This is a sitting type or push up type model. The user has to sit on the seat which is provided on upper frame and has to insert his foot between the rubber rollers available in the lower frame. The upper frame can be lifted by hands and the lower frame has to be lifted by leg. The process has to be repeated for continuous climbing.

Coconut De-Husking Machine

Coconut de-husking is the first post harvest operation in any coconut processing industry. Traditionally coconut is dehusked manually using a spike. Drudgery and risk of getting injured make the operation male dominated. A power operated semi automatic coconut de-husking machine has been designed and fabricated at

Shell Fired Copra Dryer

ICAR-Central Plantation Crops Research Institute. The machine has a capacity to de-husk 200 coconuts/hour.

Copra Dryers

The common practice of making copra is by sun drying the fresh coconut kernel on cement floor or on sand floor for seven to nine days. Unlike in other crops, the endosperm of coconut is exposed while drying and so is susceptible for contamination due to dirt. Prolonged drying, especially during monsoon, also results in microbial infection. The energy efficient dryers developed by CPCRI produce dust and microbial contamination free copra in a short period.

Shell Fired Copra Dryer

The copra dryer is working on indirect heating and natural convection principles using coconut shell as fuel. This dryer requires less amount of fuel, makes copra in short time and is less expensive too. Capacity of the dryer is 1000 nuts/batch. The quality of copra obtained is light brown in colour which fetches good price in the market. The burner designed generates heat for 5 hours without tending and the residual heat is retained for one more hour. The average drying time is 24 h.

Solar Tunnel Based Integrated Copra Dryer

Solar drying relies on the sun as the source of energy.

Solar Tunnel Based Integrated Copra Dryer

Coconut De-Shelling Machine

It generates higher air temperature and consequential lower relative humidity. For cloudy and rainy days, a multi source dryer has been developed with solar energy as the main source of energy and electricity and biofuel as alternate sources of energy. The dryer consists of a semi circular parallel plate solar collector, electric heaters of 1000 W (6 numbers), blower cum exhaust motor and the drying chamber. It is a auto regulated dryer with temperature and humidity control. It is a batch type dryer and the capacity of the dryer is 2000 coconuts/batch. The dryer can be used to dry other crops such as cardamom.

Coconut De-Shelling Machine

A power operated batch type coconut de-shelling machine has been developed to separate shell and copra after partial drying.

Capacity of the machine is 400 half cups/batch. The optimum average moisture content for maximum de-shelling efficiency (92.16%) is 35°/o d.b. The optimum speed of the de-shelling machine is 10 RPM and the time taken for de-shelling is 4 minutes/batch.

Tender Coconut Punch and Cutter

Copra Moisture Meter

Moisture is the most important factor influencing the quality of copra. Copra with a moisture content of less than six percent is considered good quality as it is not easily damaged by insects, moulds or microorganisms. At the CPCRI, Kasaragod, an electronic moisture meter was developed to determine the moisture content of copra, based on the electrical conductivity of the kernel. The instrument can read moisture content from 5 to 40%.

Snowball Tendernut Machine

Tender Coconut Punch and Cutter

Tender nut punch and cutter are two simple devices to pierce the tender coconut and the cut open it after drinking the water inside. A clean hole sufficient enough to insert a straw is formed and one can drink the fresh water. After drinking the water, the nut is placed on the wooden platform and cut open by pressing the lever attached to the blade.

Snowball Tendernut Machine

Snow ball tender coconut is globular tender coconut kernel containing tender coconut water inside. The ball scooped out with the help of specially devised tool after cutting the shell of tender coconut of 7-8 months maturity by using snow ball tender coconut machine.

Fresh Coconut Shell Removing Machine

Coconut shell removing is the second post harvest operation in a coconut processing industry using fresh coconut kernel as the raw material. Traditionally coconut shell is removed using a knife.

The machine developed at ICAR-CPCRI is intended to reduce both time and drudgery involved in the manual de-shelling process. Coconut to be processed is pressed towards the rotating blades by firmly placing it on the stationary blade. Shell gets detached from the kernal due to the impact force of the rotating blade. The machine has a capacity to remove the shell of 150 coconuts/hour.

Fresh Coconut Shell Removing Machine

Coconut Testa Removing Machine

Many high value coconut products like, coconut chips, virgin coconut oil, desiccated coconut etc. requires removal of testa. At present, testa is removed manually using potato peeler which is a cumbersome and time consuming process. Moreover a sizable amount of coconut meat also would be lost along with the removed testa. The coconut testa removing machine would reduce the drudgery and improve the efficiency and capacity of any production units that requires removal of testa. The main component of the machine is a circular wheel covered with cloth or water paper attached to a prime mover, an electric motor. One person can remove testa of about 75 coconuts per hour.

Coconut Testa Removing Machine

Coconut Slicing Machine

Slicing coconut kernel to produce chips of uniform thickness is the single most important unit operation in the coconut chips making process. Conventionlly this is done manually and the process is very cumbersome and time consuming. Quality of chips, especially uniformity of thickness, would depend on the skill of the operator. In order to make this operation simple and

Manually operated coconut slicing machine

Coconut chips making machine

faster, manual and power operated coconut slicing machines were developed at CPCRI.

Coconut Chips Dryers

Two types of dryers (electrical and agricultural waste fired) were developed by CPCRI to dry the sliced coconut kernel to the desired moisture content.

Virgin coconut oil cooker LPG/Biogas

Agricultural waste fired virgin coconut oil cooker

Manually operated coconut milk extractor

Coconut Pulveriser

The coconut pulveriser consists of power operated rotary blade. The coconut kernel pieces are fed into the hopper manually. Due to the impact of the rotary blade and the rubbing on the stationary blade, the coconut kernel turns into fine powder. The machine has a capacity of 250 nuts/hr.

Manual Coconut Milk Extractors

Two different manually operated coconut milk extractors are developed to enhance the milk extraction efficiency.

Screw Type Coconut Milk Expellers

Two screw type coconut milk expellers, single and double screw, with different capacities have been developed to extract coconut milk. The single screw expeller has a capacity of 300 coconuts/hour and the double screw has capacity of 1,000 coconuts/hour.

Virgin Coconut Oil Cookers

CPCRI has standardized the protocol and commercialized the technique of producing virgin coconut oil by hot processing method. Conventionally virgin coconut oil is prepared by heating coconut milk in an open container at low flame with continuous stirring. It is done manually and the constant stirring is a laborious process. Many a times the milk gets charred and the charred milk stick to the bottom and the sides of the vessel.

This happens when the stirring is not proper or when excess fuel is burnt. In order to overcome the limitations of the traditional Virgin Coconut Oil (VCO) production, two types of VCO cookers were developed at CPCRI to extract the VCO by hot processing. One machine uses LPG/ biogas as fuel and the other one uses any agricultural waste as fuel source.

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Champaran Fair 2017

Shri. Radha Mohan Singh, Hon'ble Minister for Agriculture and Farmers Welfare inaugurating the fair

Coconut Development Board participated in Champaran Fair 2017 held at Motihari East, Champaran Dist, Bihar from 15th to 19th April 2017. Shri. Radha Mohan Singh, Hon'ble Minister for Agriculture and Farmers Welfare, Government of India inaugurated the programme. Dr. A K Singh, Chairman, Coconut Development Board was an expert of the technical session which was conducted as part of the programme.

Coconut Development Board stall displayed various coconut based value added edible products and handicraft items. Attractive posters depicting the nutraceutical and health benefits of coconut and coconut products were displayed in the stall. Board's publications were distributed to the visitors. The sale of oconut products were also held in Board's stall as part of the fair.

Views of Board's stall ▶

Financial assistance for coconut based industries from Coconut Development Board

Coconut Development Board, Ministry of Agriculture and Farmers Welfare, Government of India is extending financial support for establishment of coconut based industries. Financial support is extended to the tune of 25% of the project cost limited to Rs.50 lakh and for SC/ST Women entrepreneurs, the financial assistance is extended upto 33.3% of the project cost limited Rs. 50.00 lakh per project as back ended subsidy.

Prospective entrepreneurs/ NGOs/ Co-operatives/ FPOs may avail the benefits of this scheme for setting up of coconut based industries/ units for manufacturing of coconut based value added products such as desiccated coconut powder, virgin coconut oil, coconut milk, coconut milk powder, flavored coconut milk (ready to drink), tender coconut water, coconut shell based powder, charcoal and activated carbon and any other value added coconut products.

For further details contact the TMoC cell of Coconut Development Board

Market review – March 2017

Domestic price

Coconut Oil

During March 2017 the price of coconut oil opened at Rs. 12800 per quintal at Kochi and Alappuzha market and Rs.13200 per quintal at Kozhikode market. During the first week, the price at all three markets remained same and from the second week onwards, prices expressed a declining trend. During the fourth week, the prices expressed an upward trend.

The price of coconut oil closed at Rs.13400 per quintal at Kochi market, Rs.13300 per quintal at Alappuzha market and Rs.13800 per quintal at Kozhikode market with a net gain of Rs.600, Rs.500 and Rs.600 per quintal at Kochi, Alappuzha and Kozhikode markets respectively.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.11667 per quintal, also expressed a fluctuating trend during the month. The price closed at Rs.12267 per quintal with a net gain of Rs.600 per quintal.

Table1: Weekly price of coconut oil at major markets Rs/Quintal)

	Kochi	Alappuzha	Kozhikode	Kangayam
01.03.2017	12800	12800	13200	11667
05.03.2017	12900	12800	13200	12067
12.03.2017	12500	12600	13200	11267
19.03.2017	12700	12600	13200	11533
26.03.2017	13100	13100	13800	12067
31.03.2017	13400	13300	13800	12267

Milling copra

The price of milling copra at major markets moved in tune with the prices of coconut oil. During the month, the price of milling copra opened at Rs.8100 per quintal at Kochi and Alappuzha market and Rs.8450 per quintal at Kozhikode markets. During the first week of the month prices expressed an upward trend. During the second week a slight decline in prices were observed. From third week prices expressed an upward trend and continued till the end of the month.

The prices closed at Rs.8950 at Kochi and Rs.8800 at Alappuzha and Rs.9000 at Kozhikode markets with a net gain of Rs.850 per quintal at Kochi, Rs.700 per quintal at Alappuzha and Rs.550 per quintal at Kozhikode markets.

At Kangayam market in Tamilnadu, the prices expressed a fluctuating trend during the month. The prices opened at Rs.7900 and closed at Rs. 8500 per quintal with a net gain of Rs.600 per quintal.

Table2: Weekly price of Milling Copra at major markets (Rs/Quintal)

	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.03.2017	8100	8100	8450	7900
05.03.2017	8400	8250	8500	8150
12.03.2017	8100	8150	8450	7900
19.03.2017	8300	8200	8550	7900
26.03.2017	8700	8600	9000	8300
31.03.2017	8950	8800	9000	8500

Edible copra

The price of Rajapur copra at Kozhikode market which opened at Rs.8450 per quintal expressed fluctuating trend during the first fortnight of the month. The prices expressed an upward trend and closed at Rs.9100 with a net gain of Rs.650 per quintal. During the fag end of the month , the prices registered a slight increase and the trend indicates that, prices may express an upward trend in the coming days.

Table3 :Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.03.2017	8450
05.03.2017	8400
12.03.2017	8200
19.03.2017	8500
26.03.2017	9200
31.03.2017	9100

Ball copra

The price of ball copra at Tiptur market which opened at Rs.7500 per quintal, expressed a fluctuating trend during the month and closed at Rs.8000 with a net gain of Rs.500 per quintal.

Table 4 : Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
	Tiptur
01.03.2017	7001
05.03.2017	7600
12.03.2017	7450
19.03.2017	7700
26.03.2017	8350
31.03.2017	8000

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.6950. The price expressed a declining trend during the first fortnight, thereafter expressed an increasing trend and closed at Rs.7050 with a net gain of Rs.100 per thousand nuts.

Table5 : Weekly price of Dry Coconut at Kozhikode market (Rs/1000 coconuts)	
01.03.2017	6950
05.03.2017	6850
12.03.2017	6850
19.03.2017	7050
26.03.2017	7050
31.03.2017	7050

Coconut

At Nedumangad market the price opened at Rs. 15000 and closed at Rs.14000 per thousand nuts with a net loss of Rs.1000 per thousand nuts. At Bangalore APMC, price opened at Rs.10500 per thousand nuts and closed at Rs.19000 per thousand nuts with a net gain of Rs.8500 per thousand nuts. At Manglore APMC market the price of partially dehusked coconut opened at Rs.20000 per thousand nuts and ruled at same price till the end of the month.

Table 6: Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Banglore	Mangalore (Grade-1)
01.03.2017	15000	10500	20000
05.03.2017	15000	10500	20000
12.03.2017	14000	16000	20000
19.03.2017	14000	17000	20000
26.03.2017	14000	19000	20000
31.03.2017	14000	19000	20000

Tender coconut

The price of tender coconut at Maddur APMC market in Karnataka opened and closed at Rs.10000 per thousand nuts. The price of tender coconut remained same throughout the month.

Table7 : Weekly price of tender coconut at Maddur market (Rs/1000 coconuts)	
01.03.2017	10000
05.03.2017	10000
12.03.2017	10000
19.03.2017	10000
26.03.2017	10000
31.03.2017	10000

International price

Coconut oil

The international (CIF Rotterdam) and domestic price of coconut oil at Philippines and Indonesia expressed an upward trend during the month. The domestic price of coconut oil in India opened at US$ 1931, declined during the second week, thereafter expressed an upward trend and closed at US$ 2003 per MT. The price of coconut oil quoted at different international/ domestic markets is given below.

Table 8: Weekly price of coconut oil in major coconut oil producing countries March 2017

	International Price(US$/MT)	Domestic Price(US$/MT)		
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	India*
04.03.2017	1476	1450	1455	1931
11.03.2017	1512	NQ	1478	1875
18.03.2017	1540	1570	1514	1933
25.03.2017	1600	1570	1514	2003

* Kochi Market

Copra

The domestic price of copra at Philippines and Indonesia expressed a upward trend during the month. Price of copra in Srilanka and India expressed a slight fluctuating trend.

Table 9: Weekly price of copra in major copra producing countries March 2017

	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.03.2017	890	916	NQ	1257
11.03.2017	914	916	1412	1215
18.03.2017	949	917	1448	1264
25.03.2017	1003	938	1440	1330

* Kochi Market

Desiccated coconut

The FOB price of desiccated coconut in India during the month of March was competitive compared to the prices of major DC exporting countries.

Table 10: Weekly price of desiccated coconut in March 2017

	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.03.2017	2530	2450	NQ	2305
11.03.2017	2464	2450	2627	2134
18.03.2017	2464	2463	2863	2087
25.03.2017	2464	2450	2961	2184

*FOB

Coconut

Among major coconut producing countries, the price of coconut at Philippines and Srilanka expressed a fluctuating trend. At Indonesia a slight increase in the prices of dehusked coconut was observed during the month. The domestic price of dehusked coconut in India expressed an erratic trend during the month.

Table 11: Weekly price of dehusked coconut with water during March 2017

Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
04.03.2017	246	247	266	404
11.03.2017	242	247	272	390
18.03.2017	245	247	276	403
25.03.2017	243	248	268	428

*Pollachi market

Coconut shell charcoal

The domestic price of coconut shell charcoal in India expressed an upward trend during the month and was competitive compared to the prices quoted by Philippines and Indonesia. Indonesia's price was the highest among major coconut shell charcoal exporting countries.

Table 12: Weekly price of coconut shell charcoal during March 2017

Date	Domestic Price(US$/MT)			
	Philippines	Indonesia	Srilanka	India
04.03.2017	388	469	NQ	322
11.03.2017	388	469	NQ	345
18.03.2017	388	469	352	358
25.03.2017	388	450	326	359

*Kangayam

Monthly operations in coconut gardens - May

Andaman & Nicobar Islands:

Plant the seedlings in the previously prepared pit after half filling the pit with a mixture of wood ash, sand and surface soil in a small hole dug in the centre of the pit. Provide bunds along the edge of the pit to prevent water stagnation in the pit. Clean the crown of all the bearing palms and fill the leaf axil with sand and napthalene ball mixture to prevent the attack of rhinoceros beetles

Andhra Pradesh: Prepare nursery beds. Sow seed nuts in the beds. If coconut husk is available bury it in trenches taken 3m away from the trunk between rows of palms or in circular trenches taken around the palm at a distance of 2m from the trunk. The husk is to be placed in layers with concave surface facing upwards and buried. The husk helps in the retention of moisture and supplies nutrients especially potash. The beneficial effect of husk burial will last for 5 to 7 years. Apply the first dose of fertilizers i.e. 400 g urea, 700 g single superphosphate and 750g muriate of potash to adult palms in the basin. Apply green leaf manure@ two headloads per tree and then finally cover with soil and irrigate the basins. If cattle manure is available, apply 25 kg along with the above manures. Apply ¼ cartload of tank silt depending on its availability. Plant one year old seedlings in the main field. If the attack of blackheaded caterpillar is noticed, cut down and burn the affected leaves to arrest the spread of the pest. Spray the affected palms with 0.02 per cent dichlorvos or 0.05 per cent Malathion.

Liberate specific parasites on older palms according to the stage of the pest. In a multi-stage condition of the pest, combined release of all the parasitoids is required. When an initial insecticide treatment is given the parasitoids may be released after three weeks of spraying.

If there is termite problem in the area, raise the nursery in sandy soil or apply thick layers of river sand on the bed or drench the nursery with 0.05 per cent chlorpyriphos twice at 20 to 25 days interval. If the attack of mite is noticed, spray neem oil formulation containing 0.004 per cent Azadirachtin/ Neemazal@ 4 ml/ litre of water. The spray droplets are to be directed towards the second to fifth year old bunches.

Assam: Continue transplanting of seedlings in the mainfield. Drain out regularly accumulated rain water from the pits of newly transplanted seedlings. Clean the crowns of the palms and tie or prop up bunches to prevent buckling. Take preventive measures against diseases. If termite attack is noticed, adopt soil drenching of the nursery beds and basins of newly transplanted seedlings with 0.05 per cent chlorpyriphos twice at 20 to 25 days interval. Against leaf rot disease, pour contaf 5EC @ 2ml/300 ml of water per palm around the base of the spindle leaf after cutting and removing the rotten portion.

Bihar / Madhya Pradesh/ Chhattisgarh: Increase the frequency of irrigation. Search for the incidence of termite attack/fungal disease and adopt recommended control measures. Start planting seedlings in the field by taking pit size of 1.2m x 1.2m x 1.2m in laterite soil and 1m x 1m x 1m in sandy loam soil.

Karnataka: Clean the water channels and repair the bunds. Continue irrigation, if the monsoon has not set in. Sow the seednuts before the onset of monsoon rains

and irrigate them if necessary. Give a prophylactic spray with, 1 per cent bordeaux mixture or any other copper fungicide against fungal diseases. Fresh planting may be done in previously prepared pits half filled with wood ash, cattle manure and surface soil. Irrigate the seedlings if dry spell prevails. Apply the first dose of fertilizers, organic manure (FYM) @ 50 kg and neem cake @ 5 kg per palm per year. If the attack of mite is noticed, spray neem oil formulation containing 0.004 per cent Azadirachtin/ Neemazal@ 4 ml/ litre of water.

Kerala/Lakshadweep: Search for leaf eating caterpillars and destroy them by cutting and burning the leaves infested by them. When an initial insecticide treatment is given, the parasitoids may be released after three weeks of spraying. Search for rhinoceros beetle and red palm weevil in the affected trees. The black beetle should be hooked out and destroyed. Inject the red palm weevil attacked palms with carbaryl 1 per cent using a funnel. Search for bud rot infection. If infection is found, treat with bordeaux paste and spray the neighbouring palms with one per cent bordeaux mixture as a prophylactic measure. Take basins around the palm at 2m radius and sow green manure crop in it if it has not been sown in the main field. Husk burial can be done to conserve soil moisture. Application of sufficient quantities of organic manures and balanced doses of inorganic fertilizers is recommended to improve the nutrient status of palms. Apply organic manure (FYM) @ 50 kg and neem cake @ 5 kg per palm per year. If the attack of mite is noticed, spray neem oil formulation containing 0.004 per cent Azadirachtin/Neemazal@ 4 ml/ litre of water. The spray droplets are to be directed towards the second to fifth year old bunches.

Maharashtra/Goa/Gujarat:

Plough the land once or twice and remove the grasses. Sow green manure crop such as wild sunnhemp, dhaincha, sesbania or kolinji @ 28 to 34 kg per hectare. Apply fertilizers if not given earlier.

Orissa: Dig basins around the palms. Apply green leaf and cattle manure at the beginning of the southwest monsoon. First apply the green leaf and then cattle manure and cover with soil. Apply the first dose of fertilizers @ 250g urea, 300 g single super phosphate and 400 g muriate of potash per palm. ¼, ½ and ¾ of the above doses of fertilizers may be given to 1st year, 2nd year and 3rd year old palms respectively. Start planting seedlings in the main field by taking pit size of 1.2m x 1.2m x 1.2m in laterite soil and 1m x 1m x 1m in sandy loam soil.

Tamil Nadu/Puducherry:

Continue irrigation in the garden. Apply 80 litres of water / day / palm in drip irrigated gardens or apply 500 litres of water / palm through basin irrigation once in 6 days in the western region and once in 5 days in eastern

region. Search for black headed caterpillar. If infestation is observed, cut and burn the infested leaves or portion of leaves. If the attack of black headed caterpillar is noticed spray the affected palms with 0.02 percent dichlorvos or malathion and release larval or pupal parasites 3 weeks after spraying. Repeat the spraying with copper oxychloride @ 0.25 per cent / carbendazim 0.1 per cent or root feed with 2 g carbendazim in 100 ml water if grey/lethal leaf blight is observed. Forty-five days interval should be maintained between root feeding and next harvest of nuts. Start sowing of seed nuts in the nursery and sowing of green manure crops like sunnhemp and daincha in the palm basins.

Tripura: Weed the garden and improve the drainage facilities. Transplanting should be taken up during this month. Spray one per cent bordeaux mixture if bud rot is prevalent in the garden. To protect the palms from rhinoceros beetle and red palm weevil fill the top 3-4 leaf axils of the palm with a mixture of 25g sevidol 8G with 250g fine sand. Prepare nursery beds for sowing seednuts. In areas of poor drainage make raised beds. The seed beds are to be treated with 0.05per cent chlorpyriphos twice at 20 to 25 days interval to protect the nuts from the attack of termite.

West Bengal: Prepare bunds and clean the water channels. Continue irrigation if the monsoon has not set in. Sow seednuts before the onset of monsoon and irrigate them if necessary. Dig out pits for new planting if it is not yet done. Give palms a prophylactic spray with 1per cent bordeaux mixture (Dissolve 10 g of copper sulphate and 10 g quick lime separately in 500 ml water. Pour the copper sulphate solution into the lime solution to get one litre bordeaux mixture. Check the acidity by dipping a knife or blade in the solution. If rusting is seen add more lime solution) to prevent bud rot and other fungal diseases. Apply the first dose of fertilizer if not done.