

Index

04 Message from the Chairperson's Desk



05 Horticulture Development in Lakshadweep Islands

Thamban, C., Samsudeen, K. Shameena Beegum and Jerard, B.A



13 *Heliconia stricta* 'Iris' An ornamental intercrop for shaded plantations

K Nihad, V.Krishnakumar, A. Abdul Haris and Ravi Bhat



16 Drone - an elixir for the farmers

Amit Kumar, S.K. Mehta and Gagan Mehta

21 Role of Magnesium in Coconut Cultivation

Kumaravel S



25 Barn Owl for Rodent Management in Lakshadweep Islands

Joseph Rajkumar, Thamban C. and Shameena Beegum

27 Crown choke of coconut in Assam

J.C. Nath and H.P. Maheswarappa

29 Kerala's Tender Coconut in new Avatar for Export

CDB News Bureau, Kochi



News 32

Cultivation Practices for Coconut -May 33

Market Review 37



Message from the Chairperson's Desk

Dear readers,

Hearty Greetings from Coconut Development Board!

Coconut Development Board is planning for a four pronged approach for the development of coconut farming and industry in India

The massive potential for expansion of area under coconut especially in non traditional coconut growing states is yet to be tapped. Identification of potential areas for expansion has to go hand in hand with production of quality seedlings of tall, dwarf and hybrid varieties suitable for the area. Decentralizing the production of seedlings and hybrids by providing training in hybridization and nursery management among farmers, nursery entrepreneurs, Farmer Producer Organizations etc. will help us move ahead to be self sufficient in seedling production. Expansion of area under coconut is critical in order to cater to the raw material requirement by the industry which is at present in dire shortage.



Value addition at farm level is very crucial to ensure sustainable and fair income to farmers. The research on development and demonstration of viable, state of the art technologies will be given priority by the Board. Entrepreneurship development will be promoted through seminars and workshops exclusively for value addition, exposure visit to industrial units and extending assistance through the flagship programme of the Board viz. Technology Mission on Coconut.

Market research and market promotional activities will be identified in association with reputed institutions. International opportunities for Indian products at competitive rates will be explored. The bottlenecks experienced by exporters will be addressed for effecting policy decisions. Capacity building programmes for exporters will be started soon.

Coconut cultivation by adopting recommended package of practices including micro irrigation to field, integrated nutrient management and integrated pest management is the need of the day for which Coconut Development Board will do its best. Skill development programme for labour force for harnessing and plant protection and nursery management will be encouraged. Generic promotion of value added products has to go hand in hand with the promotion of coconut industry.

Expecting your whole hearted support and cooperation

V Usha Rani IAS
Chairperson

Horticulture Development in Lakshadweep Islands - status and strategies

(Thamban, C¹., Samsudeen, K¹. Shameena Beegum¹ and Jerard, B.A².)

ICAR- Central Plantation Crops Research Institute, Kasaragod¹

ICAR-Central Island Agricultural Research Institute, Port Blair²)

Background

Lakshadweep, India's smallest Union Territory located in Arabian sea, comprises of 36 tiny coral islands with 32 sq km in area and a population of 64429 (2011 census) in the ten inhabited islands. Besides fishing and tourism, coconut cultivation, production and marketing of copra constitute the major livelihood option of people of Lakshadweep islands. Farming activities in Lakshadweep islands are essentially coconut centred and efforts to improve farm sector in the islands need to primarily focus on coconut based income generating activities. Cultivation of vegetables and fruits is very meagre and the islanders mostly depend on the supply from the mainland to meet their requirements for vegetable and fruits. A team of scientists from ICAR-CPCRI recently visited different islands as part of the expert

team constituted by National Horticulture Board for survey and selection of young farmers/entrepreneurs from Lakshadweep islands for Horticulture Entrepreneurship Development Programme. The team conducted stakeholder interaction sessions and field visits to assess the coconut farming scenario in the islands and suggested strategies for sustainable coconut farming as presented below. Optimum utilization of resources, appropriate technology intervention and capacity building holds the key for development of horticulture sector in the islands.

Coconut farming in Lakshadweep Islands

Farming activities in Lakshadweep islands are essentially coconut based and hence any effort to enhance income from farming should necessarily focus on coconut cultivation and value addition.



Table 1. Coconut cultivation in Lakshadweep Islands (2017-18)

Name of island	Area (in ha)	Total no. of palms	Productivity (nuts per ha)	Production (no. of nuts)
Kavaratti	392.4	164808	35587	13964339
Agatti	338.12	142010	35880	12131746
Amini	243.5	102270	35630	8675905
Kad-amath	306.10	128562	33650	10300265
Kiltan	149.6	62832	33880	5068448
Chetlath	100.1	42042	33760	3379376
Bitra	7.7	3234	6670	51359
Androth	452.75	190155	36650	16593288
Kalpeni	258.5	108570	34550	8931175
Minicoy	426.1	146962	19980	8513478
Total	2674.87	1091445	30623.7	87609378

(Source: Department of Agriculture, UT of Lakshadweep)

Coconut palms are in abundance in all the Lakshadweep islands. As per 2017-18 statistics (table 1) coconut is cultivated in Lakshadweep in an area of 2675 ha. with annual production of 87.6 million nuts. However, it is not cultivated in a systematic and scientific manner. Though productivity of coconut in Lakshadweep islands is high compared to the national average, various constraints adversely affect coconut production. Major constraints include fragmented holdings, overcrowding of palms due to lack of adoption of optimum spacing recommended, senile and unproductive palms, lack of adoption of multiple cropping and integrated farming, lack of availability of skilled palm climbers and high wage rate, crop loss due to rodents, incidence of pests like rhinoceros beetle, eriophyid mite, spiralling white fly, diseases like bud rot, wide spread deficiency of micro nutrients like boron, low level of product diversification, lack of transport facilities, lack of storage and marketing facilities, lack of efforts for developing value chain in coconut sector, inadequate extension support etc.

i. Ecological stability and agro-biodiversity of Lakshadweep Islands

Coconut is the principal component of vegetation and the base crop in the Lakshadweep islands and plays a significant role in maintenance of ecological stability and agro-biodiversity. Overcrowding of palms is the feature of coconut cultivation in all the islands. Majority of holdings are small and marginal



and farmers try to accommodate as many palms as possible in their tiny holdings. Every farmer demarcates the boundaries of his landed property with closely planted coconut. There is no systematic replanting and gap filling with new planting is continuously done when coconut trees are damaged/ dead due to senility, diseases or natural calamities. And as such coconut gardens in the islands are having densely planted coconut palms of different age groups which adversely affect productivity. The problem is compounded by the use of planting material without assuring the quality. Crop loss due to rodent damage is mainly due to the overcrowding of coconut palms which facilitate easy movement of rodents from palm to palm. Since there is no sufficient inter space available due to overcrowding of palms, systematic inter/mixed cropping in coconut gardens also is very much restricted or rather completely absent except for planting of vegetables and fruit plants in the small area of vacant land without coconut palms available in the islands. As per the statistics made available by Department of Agriculture for the year 2017-18 average number of coconut palms per ha. in Lakshadweep is 408 compared to 175 palms per ha. recommended for the main land. The observations at the erstwhile Regional Station of CPCRI at Minicoy had revealed that per palm yield is much higher when recommended spacing is adopted compared to overcrowding situation. Department of Agriculture and Coconut Development Board have been implementing interventions in the islands for coconut rejuvenation/ replanting by removing old and senile coconut palms and replanting by maintaining optimum plant density but the coverage of the initiatives has been insignificant and without much success. Optimum spacing of coconut would favour incorporation of fruits, vegetables and spices crops for the domestic consumption as well as export to mainland.



► Strategies

- Considering the island ecosystem and socioeconomic situation, optimum palm density for coconut needs to be worked out testing with various spacing of palms that can optimally harvest available sunlight. Model coconut gardens highlighting the benefits of maintenance of optimum palm density thus worked out should be developed in all islands. It has been proved that the yield of coconut is not affected when the palm fronds do not touch each other in the field. The spacing should be such that the palms get enough sunlight during the active yielding stage i.e from 20 to 50 years of age. Spacing of 7.5 x 7.5 has been recommended for tall coconut cultivars in mainland. However, due to several factors, the palm density is observed to be very high in Lakshadweep resulting in many unproductive trees amidst good yielding trees. Sufficient interspaces in coconut plantations favour the introduction of inter and mixed crops.

- Interventions for removing old and senile coconut palms and replanting by maintaining optimum plant density should be given emphasis while formulating strategies for enhancing efficiency of coconut sector in the islands and farmers should be provided with adequate incentives for the same. Replanting should be taken up with quality planting material selected from most adapted palms under island ecosystem. However, in narrow strips of lands near sea coast, removal of coconut palms will actually put the land in problem as they serve as protective cover from winds and sea erosion. Hence, palm removal shall be avoided in the extreme coastal areas where their presence is essential for the sustenance of the coast. In other words, coconut palm removal in coastal areas is to be decided case to case basis considering the wave line and availability of other vegetation or protective rocks etc.

ii. Coconut based cropping system and integrated farming for enhancing food and nutritional security

In spite of the obvious benefits of coconut based cropping/farming system over the traditional monoculture, the extent of adoption of the same in Lakshadweep islands is very low mainly due to the overcrowding of palms due to lack of adoption of recommended spacing. Majority of holdings are small and marginal and farmers try to accommodate as many palms as possible in their tiny holdings and as such the scope for accommodating other crops and enterprises along with the coconut palms is very much limited.

In Lakshadweep islands, vegetable and fruit crops are cultivated in very small area only. Islanders mostly depend on the mainland for meeting their requirement of vegetables and fruits. Of late, many people have started growing these crops in roof top gardens in the terraces of their houses, mostly in grow bags with the support of Department of Agriculture. Vegetable crops like brinjal, bhindi, tomato, amaranthus, chilli, cabbage, cauliflower etc are grown in grow bags in terraces of houses. Vegetable and fruit plants are affected by various pests (aphids, mites, white fly, mealy bug etc.) and diseases (bacterial wilt, mosaic etc.). Due to various reasons such as lack of awareness about crop protection technologies, lack of availability of inputs for plant protection measures, inadequate extension support etc farmers are unable to effectively adopt any pest/disease management measures in vegetables and fruits. Incidence of pests and diseases, nutrient deficiencies, lack of availability of quality seeds and planting material, lack of changing/ refilling grow bags with suitable potting mixture etc are some of the problems experienced in cultivation of vegetables and fruit crops in terrace farming. Under the scheme for development of horticulture, Department of Agriculture is facilitating cultivation of vegetables, fruits and tuber crops in demonstration plots and the produce is sold to the public. Few farmers are cultivating vegetable and fruits in low lying areas of islands known as 'thottam'. Banana is mostly cultivated in such areas.

Research conducted at erstwhile Regional Station of CPCRI at Minicoy had revealed the possibility of organic production of several vegetables and fruits which includes, banana, papaya, guava, sapota, acid lime, annona, tomato, brinjal, chilli, moringa, bhendi, bitter gourd, snake gourd, ridge gourd,



cabbage, cauliflower, coriander, tapioca, sweet potato, betel vine, curry leaves, amaranthus and palak in the interspaces of coconut. Significant yield improvement could be possible through use of selected varieties with different organic nutrition and pest management practices. Coconut leaf vermicomposting and vermiwash were found to be highly useful in increasing the yield of several vegetable crops under Island conditions.

► Strategies

- Preference of farmers in the islands about the component crops including different vegetable/fruit crops and subsidiary enterprises to be integrated with coconut cultivation need to be analysed and performance of such combinations to be assessed in farmers' field. KVK Lakshadweep can take up OFTs for assessing the performance of crops and enterprises. Suitable crops/enterprise as part of coconut based farming system can be demonstrated through FLDs. In some of the Islands few farmers have made efforts to integrate cattle rearing with coconut farming. Coconut based integrated farming models suitable to the Island's agro eco system should be promoted through appropriate interventions.

- Extension activities for popularising coconut based cropping/farming systems suitable for island situations can be organised. KVK can support Department of Agriculture for conducting training on coconut based cropping/farming systems for farmers, farm women and entrepreneurs. Demonstration plots on coconut based inter/mixed cropping and integrated farming need to be established in all islands.

- Production of coconut leaf vermicompost, vermiwash to be taken up by govt and private organizations to ensure the supply of organic manures for open field cultivation as well as grow bag vegetable culture. The poultry manure available in the Islands from poultry units could also be utilized after proper curing.



- Link the interventions to promote coconut based farming systems with interventions for removing old and senile coconut palms and replanting by maintaining optimum plant density.

- Facilitate formation of FPOs and provide incubation support to take up enterprises on rain shelter farming/poly house/ hi-tech farms for production and marketing of vegetables in suitable localities in islands where open space is available.

- Facilitate formation of women SHGs to take up production and marketing of quality seeds and planting material of vegetables, fruit plants and tuber crops in farms under Department of Agriculture. Besides, potting mixture for grow bags also can be prepared and sold by these SHGs for the islanders.

- Implement interventions to support farmers for the cultivation of vegetables, fruit plants and tuber crops in the low lying areas ('thottam') and in the homesteads.

- Schemes to support farmers for effectively utilising potential for marketing of organic vegetables should also be implemented. At least one protected cultivation structure need to be established per island to address the conservation, planting material production and demonstration of vegetable production under protected structures. Development of organic production technologies for protected cultivation is necessary for the Islands as use of chemicals in farming is prohibited and not desirable.

- The transported fruits and vegetables from mainland India need to be subjected to quarantine to arrest the spread of new pests and diseases in the Islands.

- Mini refrigerated storage chambers may be provided to the farmers in the Islands for storing fruits and vegetables grown in the Islands.

iii. Conservation and utilisation of coconut genetic resources and production of quality planting material

Lakshadweep islands situated in the tropical region are home to diverse coconut genetic resources. Laccadive Ordinary Tall and Laccadive Micro Tall are the predominant coconut cultivars found in Lakshadweep islands. Laccadive Micro has the highest oil content (72%). In addition to these prominent ones, there are a few other types like Laccadive Orange Dwarf, Laccadive Yellow Dwarf, Laccadive Green Dwarf and Laccadive Mini-micro tall. Selection from Laccadive Ordinary Tall (LCT) has been released by ICAR-CPCRI as Chandrakalpa which is a high yielding tall variety. LCT is also one of the parents in the hybrid Chandralaksha released by ICAR-CPCRI. Production of planting material in these improved varieties is limited by scarcity of mother palms in the main land. Planting material production can be enhanced by utilizing mother palms in the Lakshadweep islands. Many institutions and entrepreneurs from Kerala are keen to procure coconut seednuts from Lakshadweep islands and as such the potential for production and distribution of planting material through FPOs can be utilised as a source of income to the coconut farmers in islands.

► Strategies

- Coconut genetic resources endemic to Lakshadweep islands need to be thoroughly explored and documented in the biodiversity register at village panchayat level.

- Mother palms of released varieties of coconut available in the islands should be identified and geo-tagged for production quality planting material.

- A certification process should be evolved to label the quality planting material

- Farmer Producer Organizations need to be formed, trained and facilitated to take up production and distribution of quality planting material in all islands.



iv. Organic farming and soil health management

As per the official policy of UT of Lakshadweep use of chemicals in farming is restricted. Coconut farming in the islands is natural farming without doing any cultivation practices except planting and harvesting. And it can be considered organic mode of crop production by default and no farmer applies any inorganic input in coconut farming. Soil in the islands is calcareous and sandy. As has been already mentioned, farmers are not applying any inputs to coconut palms and problems due to deficiency of nutrients are quite evident on coconut palms and vegetable and fruit crops grown in the islands. Symptoms of boron deficiency are observed widely in coconut palms in all the islands. Vegetable and fruit plants, which are grown in limited scale in the islands, are also affected by nutrient deficiencies. Soil erosion is also observed in the sea shore. Systematic efforts to assess the soil health status of islands for formulating suitable interventions for nutrient management are yet to be made. Lack of availability of quality organic manure is a limiting factor in promoting organic farming practices in the islands. ICAR-CPCRI has developed a simple technology for production of vermicompost using coconut leaves. Coconut leaves are available in plenty in the islands and this technology can be utilised effectively to make available quality organic manure required for coconut and subsidiary crops.

Since the year 2015 agriculture in Lakshadweep islands has been declared as organic and Department of Agriculture has been implementing a comprehensive programme for organic certification of farm holdings since 2007. Organic certification of farm holdings was done through an accredited third-party organic certification agency. Organic certification process has been completed in about 500 holdings in each of the islands. Organic farmers' societies were facilitated



in all the islands by the Department of Agriculture as part of promoting marketing of coconut and by products as organic. Except for conducting few meetings not many activities are being implemented through these societies and even the office bearers of these societies are not quite aware of the activities to be taken up. However, few entrepreneurs in some of the islands, especially in Andrott, have made use of the opportunity to market coconut oil branded as organic in the domestic market of islands and markets in Kerala and even abroad. A substantial amount has been spent for organic certification of agricultural holdings in the islands. It is necessary that a concrete plan for taking up various interventions viz., completing the process of organic certification of remaining holdings, implementing follow up activities such as renewal of organic certification, selecting products from the islands to be promoted and marketed as organic, ensuring premium price for the organic products, developing 'Lakshadweep brand' of organic products etc is formulated and implemented with active participation of farming community. Of late, it is learnt that a comprehensive scheme for organic certification of farm holdings in all the islands is being formulated with the support of Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, under the domestic organic certification programme under the Nation Mission for Sustainable Agriculture. Under this initiative Participatory Guarantee System (PGS) will be followed for certification of farm holdings. PGS is a quality assurance initiative that is locally relevant, emphasize the participation of stakeholders, including producers and consumers and operate outside the frame of third party certification.

► Strategies

- Efforts should be made for the comprehensive assessment of soil health status and formulation of package of practices recommendations for soil health and crop health management taking into cognizance

the local availability of inputs and policy on organic farming in the islands.

- Interventions to popularise vermicomposting of coconut leaves and raising green manure crops in coconut gardens are to be implemented to enhance the availability of quality organic manure and for improving soil fertility status. Similarly interventions have to be implemented for promoting enterprises on production of organic manure using fish waste can also be taken up.

- Farmer Producer Organisations (FPOs) are to be facilitated to take up production and marketing of organic products and incubation support provided to them through appropriate entrepreneurship development programmes.

- A common brand 'Lakshadweep organic' with logo has to be developed for exploiting the potential of organic market for the products from the Island.

v. Management of pest and diseases

Crop loss due to pest and disease incidence in coconut and subsidiary crops is a major problem experienced by farmers in the islands. It is estimated that rodent attack results in 40-50 % damage to coconut palms in the islands. Reasons attributed for the heavy damage due to rats include overcrowding of coconut palms, inadequate crown cleaning and delayed harvest of coconuts, heaping husks and fallen fronds in the coconut gardens, absence of predators like owls, snakes etc in the islands, and lack of adoption of proper crop management practices. Many farmers perceived that restriction to use rodenticides for controlling rats as per the organic farming policy has resulted in increased crop loss due to rat menace. Though the Department of Agriculture is implementing some interventions for rat control in the islands, the earlier practice of 'eli nayattu' (hunting rats) campaign conducted in all the islands covering the coconut gardens from one end to the other end of the island in which rats harbouring the crown of coconut palms were driven down to the ground and killed by a team of palm climbers and farmers has also not been conducted systematically since the last few years due to many reasons. Since Lakshadweep islands are declared as organic use of chemical methods for rat control can't be adopted and hence adoption of biological control methods for managing rat menace assumes much significance. In this background, Department of Agriculture under Lakshadweep administration has already initiated action for introducing barn owl from Kerala to the

Islands for controlling rats. Incidences of bud rot and stem bleeding disease have been observed in few coconut gardens in some of the islands. Damage due to rhinoceros beetle and eriophyid mite is noticed in all the islands. Recently, infestation of coconut palms by rugose spiralling white fly is observed in Kavaratti Island. Vegetable and fruit plants also are affected by various pests and diseases. Due to various reasons such as lack of awareness about crop protection technologies, lack of availability of inputs for plant protection measures, inadequate extension support etc., farmers are unable to effectively adopt any pest/disease management measures in coconut and subsidiary crops.

► Strategies

- Evolve package of practices recommendations for crop health management in coconut and subsidiary crops taking into account the organic farming policy for the islands.
- Organise capacity building programmes on eco-friendly crop protection technologies for coconut and subsidiary crops to benefit extension personnel, farmers, palm climbers and agricultural labourers
- Implement farmer participatory extension interventions to enhance adoption of eco-friendly crop protection technologies in coconut and subsidiary crops

vi. Value addition and commercialization of traditional products



Organic cultivation of coconut in the Islands is an advantage for the production and marketing of value added products that can be marketed worldwide as organic. Products like desiccated coconut, coconut cream, coconut milk and coconut sugar have markets all over the world. Latest additions like coconut ice-cream and coconut chocolates can find domestic and export market in the future. There are few traditional products like dweep burfy and dweep sugar that can enter the markets outside the Lakshadweep.

► Strategies

- Empower local entrepreneurs, women SHGs and Farmer Producer Organisations through skill development in production and marketing of value added products
- Develop infrastructure for production and marketing of value added products
- Procedures for providing credit support to the entrepreneurs are to be made more simple and effective by evolving appropriate norms for sanctioning credit by taking into account the prevailing socio-economic situation in the islands.

vii. Capacity building initiatives to benefit youth

Lack of availability of skilled palm climbers is a major problem experienced by farmers of all islands which adversely affect timely harvest and plant protection operations, especially rodent control, in coconut. In some of the islands the frequency of harvesting in coconut has come down to four times per year. Department of Agriculture has been implementing insurance scheme for the benefit of coconut climbers. Currently palm climbing is done by skilled workers belonging to certain sections of island population only. Service of the skilled workers from main land also is utilised by the farmers. Even though the present wage rate is quite attractive for the climbers (as high as 50 rupees per palm) climbing coconut trees is considered as an inferior job by the upper elite sections of the population. Mechanical device for climbing coconut palms is used by climbers of some islands like Kadmat only. Voluntary organizations of youth are already functioning in some of the Islands which manages small enterprises on production and marketing of value added coconut products. There are also youth clubs involved in cultivation of vegetables and fruits.

► Strategies

- Conduct sensitisation programmes to develop favourable attitude towards the job of coconut climbing among all sections of island population.
- Organise capacity building programmes in all islands for youth on coconut palm climbing using mechanical device in line with the 'Friends of Coconut Trees' scheme implemented by Coconut Development Board.
- Topics related to crown cleaning, hybridization technique for production of coconut hybrids, control measures for bud rot disease, control of rodents etc



should also be included in the capacity development programme for youth besides coconut harvesting.

- Conduct training programmes to benefit voluntary organizations of youth on production and marketing of value added coconut products, inter/ mixed cropping of fruits and vegetables in coconut gardens etc.

viii. Capacity building programmes to benefit farmers and extension personnel

As part of the coconut development schemes of Department of Agriculture, coconut farmers in the islands can be provided exposure to sustainable coconut production technologies to enhance their knowledge and skill. Apart from the training programmes on the technologies to enhance productivity and income from coconut farming the farmers are to be trained on formation and management of Farmer Producer Organisations (FPOs) to reduce cost of cultivation and to enhance income from coconut farming. Training-cum-exposure visit programmes on coconut production technologies can be organised at ICAR-CPCRI Kasaragod to benefit the coconut growers from Lakshadweep islands. Off campus training programmes for coconut farmers on selected topics also can be conducted in different islands in collaboration with ICAR-CPCRI. Similarly, extension personnel under the Department of Agriculture in Lakshadweep islands also need to be kept abreast with the advances in coconut production technologies through appropriate capacity building programmes. Training programmes on coconut production technologies can be organised at ICAR-CPCRI, Kasaragod for the extension personnel including the officers of the farms under the Department of Agriculture in Lakshadweep islands. It is worthwhile to mention here that Entrepreneurship

Development Programmes (EDP) for selected young farmers/ entrepreneurs from different islands have already been scheduled to be conducted at ICAR-CPCRI Kasaragod and KVK Baramathi with the support of National Horticulture Board. The EDP for the first batch of selected farmers from Lakshadweep islands is scheduled to begin at ICAR-CPCRI during the last week of April 2019.

An annual calendar for organizing training programmes on coconut based income generating technologies to benefit farmers, farm woman, youth and entrepreneurs of Lakshadweep Islands can be prepared. Co-ordination among agencies such as ICAR-CPCRI, KVK Lakshadweep, Department of Agriculture under UT of Lakshadweep and active participation of FPOs are essential for effectively planning and implementing the annual calendar of capacity development programmes.

► Conclusion

Coconut cultivation is the major source of income for the people of Lakshadweep islands besides fisheries and tourism and hence any effort to improve horticulture sector in the islands need to primarily focus on coconut based income generating activities. Interventions on coconut based multiple cropping and integrated farming, conservation and utilisation of coconut genetic resources and production of quality planting material, organic farming and soil health management, management of pest and diseases, capacity building initiatives to benefit youth, farmers and extension personnel are to be formulated and implemented for the sustainable development of horticulture sector in Lakshadweep islands. Active involvement of coconut growers and other stakeholders is to be ensured in the planning and implementation such interventions. ■

Heliconia stricta 'Iris'

An ornamental intercrop for shaded plantations

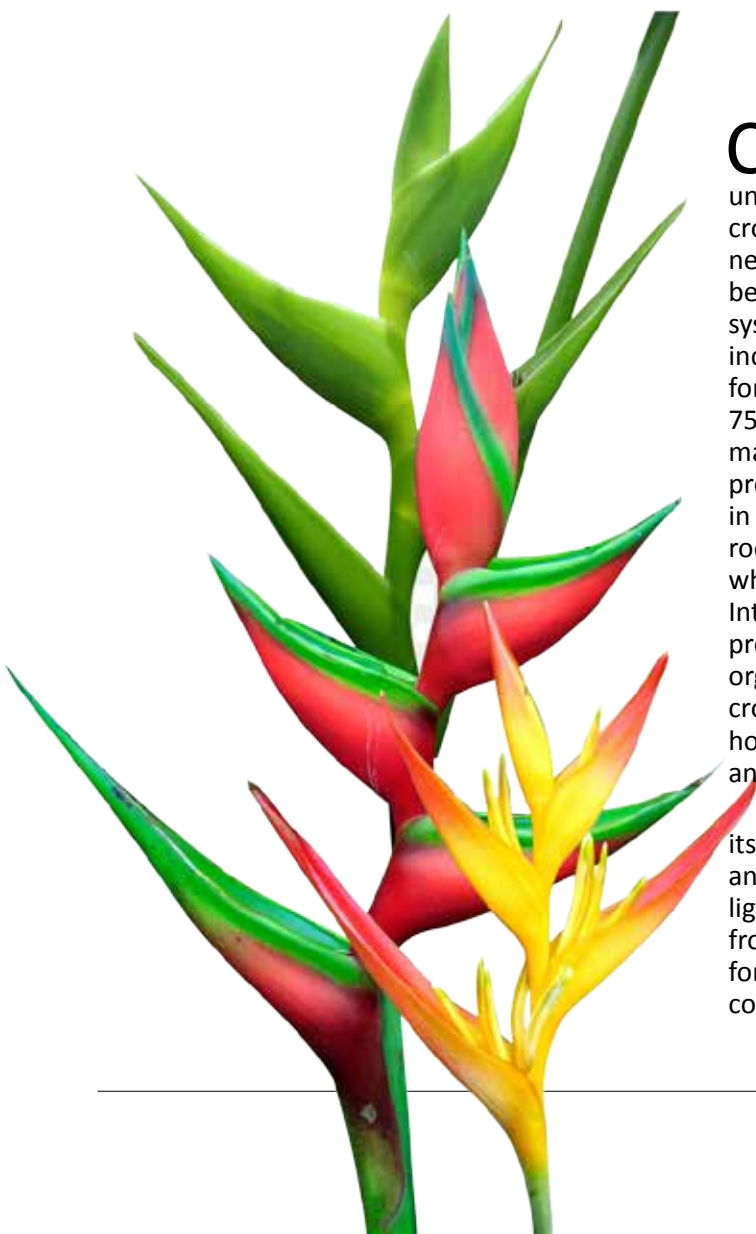
K Nihad, V.Krishnakumar, A. Abdul Haris and Ravi Bhat

ICAR-Central Plantation Crops Research Institute,
Regional station, Kayamkulam



Coconut (*Cocos nucifera* L.) is the major plantation crop of coastal India which is often remunerative under crop diversification. Unlike other plantation crops, due to the unique canopy and root structure, nearly 78% of land in coconut plantations can be effectively used for establishing intercropping system. Many sustainable cropping system models incorporating various intercrops have been identified for coconut plantations that can provide more than 75% light intensity. Growing flower crops of higher market demand and requiring lesser light is a promising venture which can be effectively adopted in coconut plantations. Flower crops have shallow root system, thus demanding continuous irrigation which in turn favours the growth and yield of palms. Intercropping also encourages crop diversity, by providing habitat for a variety of insects and soil organisms that would not be present in a single-crop environment. In addition, flower crops attract honey bees that are important in coconut foraging and pollination.

Heliconias are tropical ornamentals grown for its outstanding flower diversity in form, colour, size and particularly, its durability. The requirement of light for growth and flowering of *Heliconia* varies from species to species. There is great potential for growing shade loving *Heliconia* as intercrop in coconut gardens.





For Heliconia cut flower industry, the characteristics of interest are:
Production of inflorescences during the whole year
Short flowering cycle
Flowering stems that are light in weight for lower transportation costs
Flower stems or peduncle longer than 80 cm
Inflorescences with no wax and no hair; and bracts arranged in one plane for easier handling and packing
Inflorescence length of more than one meter
Firmness of bract
Bract with few or no flowers inside
Post harvest durability or vase life of more than seven days.

Heliconia stricta 'Iris' is a commercial variety with all the above preferred characteristics. Based on the inflorescence characters such as fresh weight of stems (101 -200 g), stem diameter (10.1-30.0 mm), stem length (50.1-150.0 cm) and spike length (10.1-30.0 cm), Iris variety is categorized under High Performance group. Depending on the marketing channel, a single inflorescence of *Heliconia stricta* 'Iris' can fetch Rs. 20 to Rs. 250 in the national market. Large flowers of this variety with more than one meter length can fetch \$2 to \$18 each in the International markets. At least 4 to 5 marketable inflorescences are produced in the first year of planting itself. It produces 45-50 inflorescences/clump/year in the subsequent years. *H. stricta* needs to be replanted in every 3-4 years.

Unlike other cut flowers such as anthurium and orchid, *Heliconia* 'Iris' comes up well in the natural microhabitat of coconut canopy. Experiments conducted at ICAR-Central Plantation Crops Research Institute have found that *Heliconia stricta* 'Iris' as a potential intercrop which can be introduced profitably in plantations with higher shade intensity of 60 to 65%. Growing heliconias in the interspaces improved soil moisture retention in coconut rhizosphere due to frequent irrigation which also resulted in reduced button shedding and increased fruit setting in such palms.

Planting material

Rhizomes taken from seven months old, healthy vegetative suckers are to be used for planting.

Planting

Planting can be done except during winter and heavy monsoon seasons. However, the ideal time for planting Iris is from August to November. For commercial cultivation, at least 250 plants are to be planted which requires 25 cents of coconut plantation. The rhizomes are planted in pits of size 30 cm x 30 cm x 30 cm at 1.5 m leaving a distance of 2 m around the coconut basins. The pits are refilled with topsoil mixed with dried cow dung (1 kg/pit) and bone meal (250 g/pit). Mulching with dried leaves or coir pith is to be done after planting. Rhizomes start sprouting at 45 days after planting.

Irrigation

Heliconia plants always require moist soil. It needs to be irrigated once in two days during summer. However, the frequency of irrigation can be reduced to once in four days by providing mulching with coir pith compost during February-March.

Manuring

Heliconia 'Iris' can be grown either as purely organic or integrating organic manures and chemical fertilizers. The manures and fertilizers are applied at quarterly intervals beginning from three months after planting. For organically grown *Heliconia*, 200 g vermicompost and 100 g neemcake are applied per plant at three months interval. Dried coconut leaves can be converted to vermicompost using earthworms (*Eudrillus sp.*). Half the dose of vermicompost and neemcake (100 g and 50 g per plant) along with 13:5:13 NPK (5 g/plant) can be given at three months interval for integrated method of cultivation. In both the conditions, drenching diluted cow dung slurry in the ratio of 1:10 at six monthly intervals enhances the production of quality inflorescence.

Thinning of eight months old suckers with less than 7 cm diameter should be carried out monthly for promoting production of more number of quality inflorescences.

Plant protection

No major pest is recorded in *Heliconia* 'Iris'. However, fungal rotting of leaves is common during heavy monsoons. Prophylactic spraying with carbendazim 50% WP @ 1 g/l is to be adopted for controlling leaf rot.

Yellowing

Yellowing of leaves during the early growth stages is noticed in *H. stricta*. This is mainly due to nutrient deficiency, particularly of potassium. If yellowing persists, soil application of 60 g muriate of potash per plant is recommended at vegetative phase.

Harvesting

Heliconia 'Iris' starts flowering at eight months after planting. The harvesting is usually done before 9 am or after 4 pm by cutting the rhizomes at ground level along with the inflorescence. After cutting, the outer leaves are to be stripped off and the top most leaf blades are cut leaving the petiole. The inflorescences have 10-12 days of vase life and can be used in stage decorations, bouquet making, long flower arrangement etc.

Inflorescences of around one meter length and nine centimeter stem girth with two or more open bracts are preferred for sale. Smaller inflorescences can be used for value addition such as bouquets and table top arrangements. The cut end of the inflorescence stem is dipped in tap water for about an hour to remove the field heat. They are then washed in water for removing soil and dust. The excess water is wiped off and inflorescences are graded based on their length. Inflorescence with fewer flowers inside the bracts are ideal for marketing as it will reduce time and cost of cleaning and minimize occurrence of insects, odours from water accumulation and organic matter deterioration.

Grading

Inflorescences of *Heliconia* 'Iris' can be graded based on their length, stem girth and spike width.

Grades	Length of inflorescence (cm)	Stem girth (cm)	Spike width (cm)
Grade I	>100	>9	>25
Grade II	75-100	7-9	20-25
Grade III	<75	<7	<20

Packing

Inflorescence can either be packed individually or in bulk. Care must be taken to exclude ants, bees etc. before packing. Bulk packing needs minimum of 45 inflorescences and inflorescence of uniform size are packed in a single box. Different materials such as aluminum foil, butter paper and news papers or recycled papers can be used for wrapping the inflorescence.

Cultivation of Heliconias can open up scope for employment generation and youth empowerment through value addition such as bouquet making, flower arrangement, stage decoration etc. Additional labour employment of 1000, 1500 and 1800 man days/ha, respectively during the first, second and third years can be created through Heliconia cultivation.

Economics of cultivation

The economics of intercropping *Heliconia stricta* 'Iris' for three years in one hectare of coconut plantation is as follows :

Year	Input cost (Rs.)	Returns (Rs.) through sale		Net returns (Rs.)	Benefit cost ratio
		Inflorescence @ Rs.20/-	Rhizomes @ Rs.60/-		
I yr	146750	24000	-	-122750	
II yr	255000	540000	225000	510000	3:1
III yr	400000	675000	540000	815000	3:1

The initial cost of cultivation is very high due to the cost of planting material which may require financial support from banks or financial institutions. The cultivation of Heliconias can also open up scope for employment generation and youth empowerment through value addition such as bouquet making, flower arrangement, stage decoration etc. Additional labour employment of 1000, 1500 and 1800 man days/ha, respectively during the first, second and third years could be expected. Export of flowers to emerging markets like Middle East and Europe offer opportunities for market development and earning valuable exchange to the nation. ■



Amit Kumar, Dr. S.K. Mehta and Gagan Mehta

Deptt. of Extension Education, CCS Haryana Agricultural University, Hisar

Dept. of Horticulture, CCS Haryana Agricultural University, Hisar

Practical application for Unmanned Aerial Vehicles (UAVs) commonly referred to as drones have progressed significantly in the recent years as the technology has improved in tandem with a fall in its cost. Interest from both consumers and businessmen in drones is growing with the new applications being developed rapidly for use across many industries including agriculture, one of the primary sectors which is expected to see sharp uptake of drone technology in the near future.

Information and Communication Technology (ICTs) is playing a vital role in addressing problems occurring in agriculture due to climate change alone are enormous. The need for the farming communities to adapt and become resilient is key to feeding the world's growing population. Harnessing the growth and transformative potential of ICTs are tremendous. The challenges faced by agriculture platform not only inculcate some of these challenges, but also accelerate the efforts to achieve the Sustainable Development Goals (SDGs) by 2030. Drones are used in various fields ranging from the military, humanitarian relief, disaster management to agriculture. A recent PwC report (PwC, 2016) estimates the agriculture drone market to be worth USD 32.4 billion. Based on particular project requirements drones can be equipped with

a range of image data sensors. The most established application based on drone-acquired image data is to assess the health of crop vegetation. Nowadays, drone technology is more and more often employed in insurance, with agriculture claims management being one of the key applications. Another, rather non-obvious application of drone imaging and mapping capabilities is counting and taking stock of herds of animals. Such an approach would lead not only to the improvement of dosage in the affected areas, but also to a reduction in the overall use of chemicals within the area. There are a number of applications of drone technology convergence with advanced image data analytics that can be utilized in the agriculture industry. Our recent estimations valued the addressable market for drone application in agriculture at USD 32.4 billion. Farmers have always needed accurate and up-to-date information on the health of their crops and the environmental condition of the land. Agricultural aircraft have been in use since the 1920s, while agricultural experts increasingly use satellites to assess crop health from the sky. UAVs are a natural progression from macro to micro, from large-scale to small-scale farms.

Drones haven't had a significant impact on agricultural practices until recently. From the ability to image, recreate and analyze individual leaves

on a corn plant from 120 meters height, to getting information on the water-holding capacity of soils to variable-rate water applications, agricultural practices are changing due to drones delivering agricultural intelligence for both farmers and agricultural consultants. Unfortunately, many of the promises being made to farmers by drone service providers simply couldn't deliver, even backed up by proper research yet. Until now air space controllers did not open segments of airspace above agricultural areas for commercial drone agricultural research to take place. The service providers with an open airspace to a specific flight height will also be able to use drones to provide better planting and crop rotation strategies and to provide a higher degree of all-around monitoring of how crops are progressing on a day-to-day basis in different parts of a given crop field, as well. In the coming years all of the possible uses for drones will be fleshed out by drone service providers and farmers itself. A boost in crop intelligence will make farms more efficient and help smaller operations compete with their more well-heeled Big Agriculture competitors. A widely-cited drone report released by the Association for Unmanned Vehicle Systems International predicts that the legalization of commercial drones will create more than €70 billion in economic impact such as revenues, job creation between 2015 and 2025, and that precision agriculture will provide the biggest piece of that growth. For now here are five drone agricultural applications already being implemented in the field.

Empowering local communities and fighting pests

The technology also has the potential to empower indigenous communities to document illegal occupations of their territories and natural resources as is described in this article. With UAV-gathered imagery of illegal logging and land occupancy government agencies can prioritize and speed up their inspection efforts ensuring that a week-long field inspection will collect enough evidence to justify government intervention.

Enhances Capacity Building

Awareness and education – or a lack thereof – presents another barrier to the adoption of UAVs in the developing world. While drones are relatively easy to use, farmers still need local language training and technical support before they get started, as well as up-to date information on the technologies

Harvesting coconut is becoming a difficult task since many of the trained workers are no longer working and the current generation is showing little interest in this job. Thus, the invention of new machines is becoming extremely necessary in order to revive coconut farming.

and legal status in their country. UAV operators need adequate access to electricity (for charging batteries) and the ability to obtain or craft spare parts. Processing drone data is another challenge: producing maps, 3D models, and other useful data outputs require considerable computing power, or Internet and mobile data that's quick enough to access cloud-computing services. Drone operators, farm workers and workers will need to develop methods of keeping UAVs functional in more remote areas.

Application of Drones

► 1. Mid-Season Crop Health Monitoring

The ability to inspect in-progress crops from about 100 meters height using Normalized Difference Vegetative Index (NDVI) or near-infrared (NIR) sensors is, thus far, the premier application for drones in farming. This was a task traditionally performed by often-reluctant college interns walking into the fields with a notepad. Drones from the present generation, allow for coverage of more surface area in a much shorter time stretch, as well as the capturing of data that cannot be seen by the human eye (like the NDVI or near-infrared). Moreover, it removes much of the human error aspect of traditional inventory work, though a physical inspection of an area of concern after viewing the imagery is still recommended

► 2. Irrigation Equipment Monitoring

Managing multiple irrigation pivots is laborious, especially for large growers with many fields spread out across large regions. Once crops like corn begin reaching certain heights, mid-season inspections of

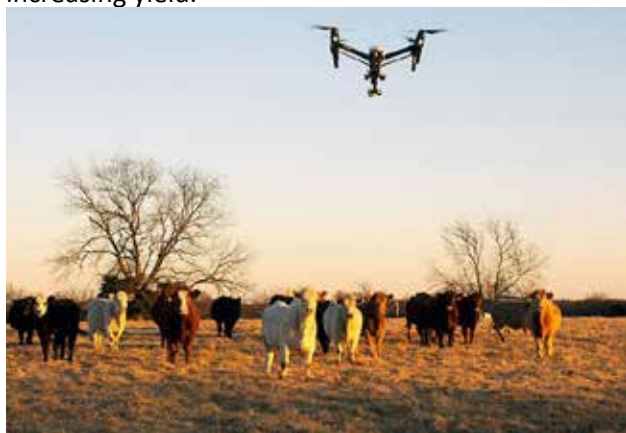
the nozzles and sprinklers on irrigation equipment that deliver the much-needed water really becomes a painstaking exercise.

► 3. Mid-Field Weed Identification

Using NDVI sensor data and post-flight image processing to create a weed map, farmers and their agronomists can easily differentiate areas of high-intensity weed proliferation from healthy crop areas growing right alongside them. Historically, many farmers haven't realized how pronounced their weed problem is until harvesting was performed.

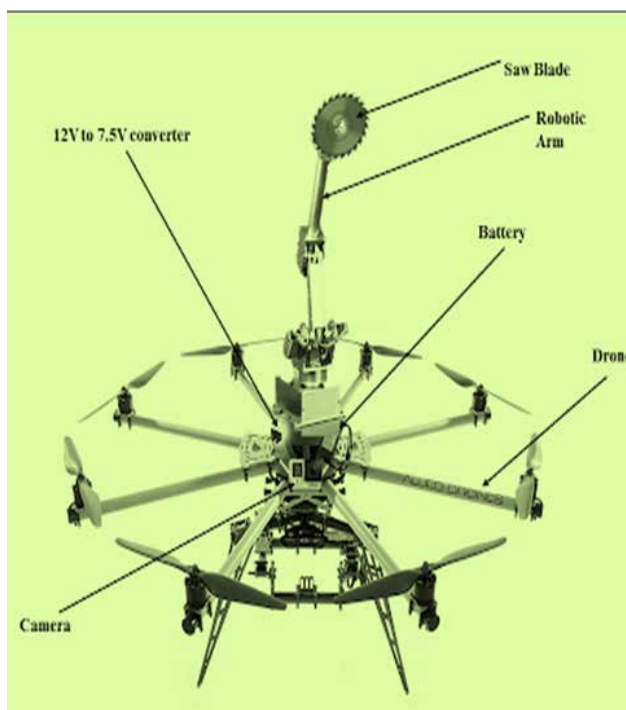
► 4. Variable-Rate Fertility

Though many will argue that ground-based inspections combined with satellite imagery, along with a dedicated grid soil sampling program is more practical for the purpose of refining Nitrogen, Phosphorus and Potassium applications in agriculture, drones do have their fit. A drone service start-up company in the US has used NDVI maps to direct in-season fertilizer applications on corn and other crops. By using drone-generated, variable-rate application (VRA) maps to determine the strength of nutrient uptake within a single field, the farmer can apply 300 kg/ha of fertilizer to struggling areas, 200 kg/ha to medium quality areas, and 150 kg/ha to healthy areas, decreasing fertilizer costs and increasing yield.



► 5. Cattle Herd Monitoring

Many growers during periods of depressed commodity prices made the call to diversify their farms by adding cattle or swine operations. Drones are a solid option for monitoring herds from overhead, tracking the quantity and activity level of animals on one's fields. They are especially helpful for night-time monitoring due to a human's eye's inability to see in the dark.



► 7. Health assessment

It's essential to assess crop health and spot bacterial or fungal infections on trees. By scanning a crop using both visible and near-infrared light, drone-carried devices can identify which plants reflect different amounts of green light and NIR light. This information can produce multispectral images that track changes in plants and indicate their health. A speedy response can save an entire orchard. In addition, as soon as sickness is discovered, farmers can apply and monitor remedies more precisely. These two possibilities increase a plant's ability to overcome disease. And in the case of crop failure, the farmer will be able to document losses more efficiently for insurance claims.

► 8. Coconut Harvesting Drone

Coconut production plays a key role in the economic and cultural upliftment of many of India's southern states. In fact the state of Kerala is widely known as 'land of coconut trees'. Harvesting coconut is becoming a difficult task since many of the trained workers are no longer working and the current generation is showing little interest in this whole concept. Thus, the invention of new machines is extremely necessary in order to save coconut farming. The goal of this project is to create a coconut harvesting drone which will revolutionize the coconut production in many of India's southern states particularly Kerala. The aim of this drone is

to cut ripe coconuts. This drone will be a manually controlled quad-copter, consisting of a camera and sensors to determine whether the coconut is ripe or not. Some of the technical challenges that we might face during the production of drone would be determining adequate amount of power for moving parts of the copter, finding appropriate sensor that can tell whether the coconut is ripe or not, and a capable robotic arm that can cut the coconuts.

Drones to boost agricultural production and help maintain food security

Subsistence farming using bullocks was largely replaced with large tracts of land ploughed by tractors and mechanized harvesters and using GMOs to enhance crop immunity. And now the next phase in the evolution of agriculture is a large-scale single crop unit that would give unprecedented output because drones would be deployed for multiple functions. With rapidly growing population, environmental degradation, global warming and the reduction in arable land, food security will be an acute issue and feeding the teeming population would require innovation in agricultural methods and the extensive use of drone technology. By 2050, the global population will be around 10 billion, and to avoid food shortage, agricultural production will have to be doubled.

Multiple applications

Apart from capturing aerial imagery, drones would also be used for sprinkling water and pesticides on the crops. This would save both time and wastage. Spraying using drones would be highly targeted and the drone would figure out and spray as per-requirements. Similarly, drones can be deployed to spray herbicides on the farms. This would be a highly efficient method as currently herbicides are sprayed over the entire length and breadth of the form, but using drones herbicides would be sprayed directly on the unwanted weeds in the farm. Other special types of drones can also determine the exact quantity of fertilizers that would be needed in the fields. This would not only save fertilizers but also maintain ecological balance, as less of ozone-depleting gasses would be emitted with a targeted usage of fertilizers. Using a machine known as Green seeker, sensors measure crop nitrogen deficiencies in real time and then predict yield potential for the crop using the agronomic vegetative index NDVI. Drones would benefit farmers and everyone engaged in the agricultural sector in numerous ways. Farmers would



Drone it's Applications covering all aspect using in smart agriculture

be able to save time, money, and increase their knowledge about the growth patterns of different crops. Simultaneously, increased productivity and environmental protection would be in tandem.

Challenges ahead

While the potential for drone use in agriculture is significant, there are still several notable impediments to their progression beyond the niche market they occupy today.

Difficult financial situation of many farms likely to hamper adoption

Agriculture remains a difficult, low-marginal business for many farmers, with government frequently assisting when adverse weather of

market condition arises. Despite their savings-potential, drones still require substantial capital investment and technical expertise to be acquired and properly function for many small or medium sized farms that are less likely to benefit from economies of scale. Generally drones are directly used by farmers in agriculture or cooperatives of farmers. Alternatively they are also used by drone company representatives who are hired by farmers

Strengthening farmer to be modernized

Global uptake of new technology requires adopting and modernizing production practices in order to obtain the best return on this investment. With over 56% of the workforce aged over 55 in Europe, digital skills are often lacking which means that additional investment in training is often required. As per the study revealed by United States Department of Agriculture, 73 % of farmers are using computers for business purpose and the remaining

39 % belongs to Smartphone and Agricultural work (Farm) accordingly.

If this UAV based surveillance system is applied widely in the near future, millions of farmers will be able to benefit from the acquisition of real time farm information. Farmers need not spend significant amount of time on acquiring farm data and will have access to disaster warning and weather information when a disaster event occurs. Nevertheless, the UAV technology is still not mature enough for large-scale application. More UAV research and development work is required, including the development of applications for fishing, poultry and farming enterprises .It is difficult to predict the future of UAV technology in agriculture, but there are many promising trends and pilot projects. Analyzing UAV data is likely to enable farmers to swiftly identify the movements of larger crop pests, from wild boar to elephants. Yet more uses for drones are likely to be dreamed up in the near future. ■

Advertisement Tariff of Coconut Journals

Indian Coconut Journal (English monthly), Indian Nalikeral Journal (Malayalam monthly), Bharatiya Nariyal Patrika (Hindi quarterly), Bharatiya Thengu Patrike (Kannada quarterly) and Indhia Thennai Idazh (Tamil quarterly) are the periodicals of the Coconut Development Board. These journals regularly feature popular articles on scientific cultivation and other aspects of coconut industry. The journals are subscribed by farmers, researchers, policy makers, industrialists, traders, libraries, etc.



Position	Indian Coconut Journal (English monthly) (Rs.)	Indian Nalikeral Journal (Malayalam monthly) (Rs.)	Indhia Thennai Idhazh (Tamil quarterly) (Rs.)	Bharatiya Nariyal Patrika (Marathi Bi-annual) (Rs.)	Bharatiya Kobbari Patrika (Telugu Bi-annual) (Rs.)	Bharatiya Thengu Patrike (Kannada quarterly) (Rs.)	Bharatiya Nariyal Patrika (Hindi quarterly) (Rs.)
Full page - B & W	No B&W pages	No B&W pages	5000	5000	5000	5000	No B&W pages
Full page - Colour	20000	20000	10000	10000	10000	10000	5000
Half page - B & W	No B&W pages	No B&W pages	3000	3000	3000	3000	No B&W pages
Quarter page - B & W	No B&W pages	No B&W pages	1500	1500	1500	1500	No B&W pages
Back inner cover - Colour	25000	25000	10000	10000	10000	10000	8000
Back cover - (Colour)	30000	30000	15000	15000	15000	15000	10000

Special package : A rebate of 10% will be allowed on advertisements inserted in any two editions of the journal at a time and 12% discount if inserted in three or more editions at a time. 15% discount will be given to bonafide advertising agents.

Role of Magnesium in Coconut Cultivation

Kumaravel S,

Development Officer, Coconut Development Board, Kochi-11

All plants require nutrition in required quantities for proper functioning and development. The plants uptake the nutrients present in different forms in the soil. These nutrients play specific and combined roles in the metabolism/ various activities of the plant. The essential elements are classified as primary, secondary and micronutrients in the light of the roles they play in plant metabolism. Only the combined effects of these nutrients in adequate quantities with other favourable environmental and soil conditions including moisture availability, can facilitate maximum output. This is a brief compilation of studies related to role of magnesium in coconut cultivation.



Essential elements in coconut nutrition and role of magnesium

Coconut is a perennial plant with commercial importance. The rhizosphere of coconut is very limited compared to its biomass production and the palm extracts more nutrients from the limited soil volume to meet the year-round vegetative and reproductive growth in its life span of more than 60 years. Hence, if not properly manured, decline in productivity is often observed.

Potash has been found to be most important in coconut cultivation, followed by nitrogen. Taking into account the nuts, fallen leaves, spathes and the stem growth Pillai and Davis (1963) computed the annual exhaust of 65.6, 29.7, 84.5, 47.4 and 20.3 kg of N, P_2O_5 , CaO and MgO, respectively from one hectare of 173 palms in sandy loam soil and observed the quantitative order of requirement of major nutrients for adult bearing palm as $K > N > Ca > Mg > P$. The leaves contain 75% of total calcium and 53% of total magnesium.

Magnesium plays an important role in photosynthesis and greenness of leaves, protein synthesis and has beneficial effects on the general growth and productivity of palm. It improves production of more female flowers, high setting percentage and more number of nuts per bunch. Application of magnesium increases Mg content in the lecithin of copra.

Coconut is being cultivated in red, lateritic and sandy soils, in general, which are naturally poor in soil fertility. Secondary and micronutrient deficiencies are emerging as potential yield limiting nutrients for coconut. Among these, supply of magnesium, sulphur, boron and zinc are very important since they are generally in short supply in many of the coconut growing tropical soils. In India, both magnesium and sulphur are either deficient or tending towards deficiency in most of the soils in Kerala, Karnataka, Maharashtra and North Eastern States of India.

Magnesium deficiency is caused by insufficient Mg in the soil. Magnesium is readily leached from sandy soils and other soils having little cation exchange capacity. Mg deficient chlorosis is very common in most of the high rainfall regions. Mg is said to be deficient in coconut when the leaf Mg level goes below 0.2%.

Magnesium plays an important role in photosynthesis and greenness of leaves, protein synthesis and has beneficial effects on the general growth and productivity of palm. It improves production of more female flowers, high setting percentage and more number of nuts per bunch. Application of magnesium increases Mg content in the lecithin of copra.

Correlation of Mg with other elements

Magnesium has positive and antagonistic effects with other elements in nutrient uptake by palms. Potassium is the most important element a coconut palm needs. Magnesium brings out full benefit of K-fertilization. However, liberal application of potash interferes with Mg uptake. A depressive effect on Mg content of copra was observed on potassium chloride application, due to K:Mg antagonism (J. Ohler).

Inadequate supply of magnesium adversely affects the translocation of phosphorus from roots to shoots which leads to delayed flowering. With calcium, a depressive effect of potassium and magnesium fertilizer was observed. The uptake of K, Mg and Na by coconut is often antagonised by very high availability of Ca in coral soils. Application of kieserite increased Mg contents in the husk and albumen. The shell does not contain P, Ca or Mg. Chlorine enhances better absorption of potash, phosphate and magnesium. Deficiencies of calcium, magnesium and potassium in the nutrient solution may also cause iron deficiency (Ohler).

The importance of balanced nutrition for better productivity in coconut is revealed from

the observations by Mathewkutty et al. (1997) that continuous use of conventional fertilizers in middle aged WCT palms have lead to a stage of negative response owing to the deficiency of non recommended/applied elements like Mg and S and excess of Ca, Fe and Mn limits coconut yield.

The varietal differences on Mg sensitivity were also observed. Dwarf coconuts are more sensitive to magnesium deficiency than talls and hybrids (Ohler).

Under HDMSCS or coconut–grass and coconut–cocoa, where recycling of organic wastes was carried out, the results showed a decline with respect to Mg over the period (Bavappa and Jacob 1982, Biddappa et al. 1993). Similarly, a decrease in available Ca, Mg, Mn, Cu and Zn was observed in mixed farming system, though organic carbon, N, P, K and Fe status of soil has improved. (Maheswarappa et al. 1998 and Subramanian et al. 2014).



It does not mean that intercropping/ mixed cropping is detrimental to coconut. The elements are taken by different crops based on several conditions and they have to be supplemented properly.

Deficiency symptoms

In general, Mg forms the central atom of chlorophyll and hence has important role in photosynthesis. Hence, the deficiency causes chlorosis. As Mg is mobile in nature, the chlorophyll in older leaves are broken down and transported to younger ones which have greater photosynthetic needs. Hence, chlorosis due to Mg deficiency appears first in old leaves which later resembles in younger leaves as the deficiency progresses. Decrease in Mg levels in plants lead to decrease in photosynthetic and enzymatic activity

within the plants as magnesium also acts as an activator for many critical enzymes, including those enzymes essential for carbon fixation. Magnesium is also crucial in stabilizing ribosome structures, hence, lack of magnesium causes depolymerization of ribosomes leading to premature aging of the plant.

As far as coconut is concerned, Mg deficiency may be one of the reasons for reduced yields. Visual symptoms alone are usually sufficient to diagnose Mg deficiency. Magnesium deficiency is characterized by chlorotic bands observed along the margins with the central portion of the leaves remaining distinctly green in the oldest leaves of palms. In severe cases leaflet tips may become necrotic. Older leaves become bronzed and dry in appearance. Leaflets show necrosis and turn to reddish brown with translucent spots. Yellowing starts at the tip and spreads to the base. The youngest leaves remain green. Mg deficient leaves are more sensitive to sunlight. The yellowing occurs principally in those parts of the leaves exposed to sunlight, the shaded parts rarely showing chlorosis.



The Mg and K deficiency can be differentiated that discoloration in K- deficient leaves is usually orange to bronze, shading gradually to green at the base of the leaf, whereas Mg- deficient leaves have distinctly green leaf centers and bright lemon yellow to orange margins.

However, the deficiency symptoms are visible only after a long time of the shortage of Mg and the negative impacts might have started much earlier. Monitoring of mineral contents in the palm is therefore imperative for good management. The three main systems used to determine fertilizer needs are leaf analysis, soil analysis and fertilizer



experiments. Leaf nutrient testing will be a promising tool to identify the existing crop nutrition related constraints in the perennial plantations like coconut and site-specific nutrient management options to improve the crop productivity. A critical level of 0.2% Mg (frond 14) under West Coast condition of India (Cecil, 1981, 1988); 0.24 to 0.25 % for the coastal sandy soil track of Odisha (Acharya and Dash, 2006) 0.30% for the West African Tall palms (by IRHO, Thampan 1982) have been worked out.

Management and other corrective measures

Growth and yield potential of palms is related to availability of the most limiting nutrient. The plant nutrient limitation may occur through the low nutrient content in soil or the antagonistic effect of the high content of other nutrients. Therefore, sufficient supply of all the nutrients depends on the balanced nutrient status in the soil.

Coconut responds very well to judicious fertilizer application and irrigation. Soil and leaf analysis of palms under different cultural and fertilizer treatments strongly suggests that for satisfactory growth and productivity of palms in the red sandy loam soil, mere cultural treatments alone cannot improve the nutritional status of palms and supplementing the nutrition with inorganic fertilizer and organic manures is necessary to sustain productivity (Khan *et al.* 1996).

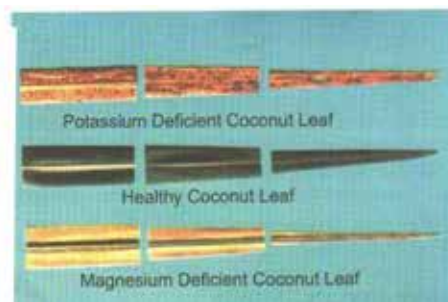
Soil application of MgSO_4 @ 1-2 kg/palm/year or Root feeding of 200 ml of 0.2% MgSO_4 twice a year is recommended by Tamil Nadu Agricultural University. Application of 1 kg lime or dolomite during April-May, 0.5 kg magnesium sulphate during August-



A coconut frond with Magnesium deficiency



A close view of coconut leaflets with Magnesium deficiency



Comparison of Potassium and Magnesium deficient coconut leaves with healthy coconut leaf

September and organic matter during June-July per palm per year is also recommended. Application of magnesium @ 500 g MgO per palm is also reported to be advantageous for the management of root (wilt) diseased palms to restore palm vigour and sustain the productivity. Foliar application of 2% MgSO_4 solution at quarterly intervals is also recommended in some cases. Micronutrient mixtures containing Magnesium also are available in the market.



A coconut palm with green leaves in upper part and yellowing in lower part

Maheswarappa *et al.* (2013) observed that fully organic nutrient management with recycling biomass (vermicompost) + biofertilizer + green manuring + vermiwash + husk burial + mulching coconut basin could produce comparably similar yield of inorganic fertilized plots and the highest economic return. Gopal *et al.* 2007 observed that coconut leaf vermiwash is alkaline and contains N, P, K, Ca, Mg, Zn, Mn in appreciable quantities.

Chemical fertilizers are normally recommended for application when sufficient moisture is available in the soil. In case of rainfed cultivation, application of fertilizers in two split doses, i.e. 1/3 at the time of onset of monsoon showers and 2/3 at the end of monsoon. Application of fertilizers in three or four equal doses in April-May, August-September, December and February-March can be adopted in case of irrigated conditions. The fertilizers and manures are to be applied in circular basins in the active root zone i.e. at a radius of 2.0 m from the base of the palm and 10 cm deep, opened after the onset of monsoon. Magnesium sulphate is dissolvable in water and can very well be applied through fertigation also.

Achieving and sustaining higher productivity and profitability from coconut farming is the primary objective of an enterprising farmer. The price fluctuation, declining fertilizer response owing to the deteriorating soil health, increasing cost of fertilizers and lack of availability of organic manures are few of the major factors challenging the farmers to meet the objectives. The site specific soil management strategies with judicious utilization of resources, cropping systems and external application of nutrients in required quantities can improve the coconut yield in a holistic way. ■

Reference: ● 1. S K Malhotra *et al.* (2017), *Diagnosis and management of soil fertility constraints in coconut (Cocos nucifera)* : A review *Indian Journal of Agricultural Sciences* 87 (6): 711–26, June 2017/Article ● 2. J.G. Ohler (1999), *Modern Coconut Management: Palm Cultivation and Products* ● 3. http://www.agritech.tnau.ac.in/expert_system/coconut/coconut/coconut_nutrient_management.html ● 4. http://www.cri.gov.lk/web/images/pdf/leaflet/series_a/a7.pdf ● 5. <http://www.pca.da.gov.ph/coconutrde/images/gen7.pdf> ● 6. <http://farmextensionmanager.com/English/Coconut%20technology%20bank/pest%20doctor/Magnesium%20Deficiency.html> ● 7. <http://www.ikisan.com/ka-coconut-nutrient-management.html> ● 8. [https://en.wikipedia.org/wiki/Magnesium_deficiency_\(plants\)](https://en.wikipedia.org/wiki/Magnesium_deficiency_(plants))

Photo courtesy: Tamil Nadu Agricultural University, Coimbatore, India., Coconut Research Institute, Sri Lanka, Philippine Coconut Authority, Philippines.

Barn Owl for Rodent Management in Lakshadweep Islands

Joseph Rajkumar¹, Thamban C². and Shameena Beegum²

¹ICAR-CPCRI Regional Station, Kayamkulam

²ICAR- Central Plantation Crops Research Institute, Kasaragod

Barn owl (*Tyto alba*) has been an excellent predator of rodents in palm system. Absence of rat snake and barn owl population in Lakshadweep Islands as well as close spacing of coconut palms are few of the main reasons responsible for the flare up of rodent population in the Island system. About 40-50% yield loss is reported due to rodent damage in Island system. Introduction of few pairs of barn owls and the nesting boxes could be a very successful strategy in the biological control of rodents. This could form one of the classical bio-control approaches in rodent management.

Barn owls are mostly nocturnal and have powerful auditory mechanism. The face is characteristically heart-shaped and is white in most subspecies. This owl does not hoot, but utters an eerie, drawn-out shriek. Once the owl spots the rodents, it could successfully track, identify its tunnel and catches it

Crop loss due to rat menace is a major problem experienced by the farmers of Lakshadweep Islands. Since this region is declared as organic, use of chemical methods for rat control cannot be adopted and hence biological control measures against rat assume much significance.



Nesting box developed by KAU and the barn owl observing for prey at Kayamkulam



up. When large numbers of small prey are readily available, barn owl populations can expand rapidly, and globally the bird is considered to be of least conservation concern. Roosting sites include holes in trees, fissures in cliffs, disused buildings, chimneys and haystacks and are often small in comparison to nesting sites. As the breeding season approaches, the birds move back to the vicinity of the chosen nest to roost. The diet consumed can be ascertained from identifying the prey fragments in the pellets of indigestible matter that the bird regurgitates.

Kerala Agricultural University has designed effective nesting boxes that formed wonderful nesting and breeding chambers for the birds. One such nesting box installed at ICAR-CPCRI, Regional Station, Kayamkulam could attract barn owl into the chamber and started breeding. Careful introduction of barn owl into Lakshadweep Islands as part of classical biological control programme would be a clear success in the management of rodents in the Island system. In this regard, it is quite interesting to note that introduction of owls to control rats was attempted years back in Lakshadweep islands. Mr. Murkot Ramunny, who was the administrator of Lakshadweep during the period from November 1961 to April 1965 has narrated the efforts made by some of the officials of Department of Agriculture for introducing barn owls to the islands for controlling the rat menace in his book 'India's coral Islands in the Arabian sea: Lakshadweep'. He says "Our special officer (Agriculture) T.K.Mukundan, a retired Deputy Director of Agriculture, had bring in innovations. Rats were ruining coconuts. He collected a lot of



owls and took them along in the ship and let them loose on the islands. To the islanders he was known as Kooman Sahib ie owl Sahib. There everyone was a sahib"

Chemical methods cannot be adopted for managing rat menace since Lakshadweep islands are declared as organic and hence biological control methods assume much significance. In this background, Department of Agriculture under Lakshadweep administration has already initiated action for introducing barn owl from Kerala to the Islands for controlling rats. Recently three pairs (three adult male and three adult female) of barn owl were received at Kavaratti which were transported in a specially designed cage from Thiruvananthapuram zoo to Kochi and from there the owls have been transported by ship to Kavaratti. The 'operation rat hunt' will start soon after these birds get adapted to the Kavaratti island agro-climatic situations. The biological control impact is likely to be realized in the coming years in the Island. ■

Crown choke of coconut in Assam and the remedial measures

J.C. Nath and H.P. Maheswarappa

AICRP on Palms (Horticultural Research Station), Kahikuchi, Guwahati, Assam

The coconut palm, (*Cocos nucifera* Linn.), is one of the most useful trees in the world which provide all required amenities of life which include food, drink, beverage, medicine, fibre and variety of raw materials for production of an array of products of commercial importance. Every part of coconut palm is being used for some purpose or the other. On account of this, it is referred as 'Kalpavriksha' – the 'tree of heaven'. Presently, the palm is cultivated in more than 93 coconut producing countries in the world. India ranks first in productivity of coconut in the world (11,481 nuts/ha), while in production India ranks second (23,904 million nuts). It is an important cash crop of Assam mostly grown in the homestead garden as monocropping covering an area of 20.6 thousand ha with a production of 153.2 million nuts and productivity of 7440 nuts/ha which is considerably below the national average. The low production and

productivity of coconut in Assam is primarily due to lack of proper management practices, incidence of diseases and pests etc. although Assam is endowed with favorable soil and climatic condition for growing of coconut. The alluvial clay loam with acidic nature soil of Assam often exhibited boron deficiency in coconut palms resulting in a disorder called crown choking. Recently, the malady is frequently observed in coconut growing areas of Assam because of which decline in the production and productivity of coconut is recorded in the region. Earlier there was a recommendation of application of borax at 50 g/palm/year to the coconut basin for the recovery of the affected palm (Chakravarty and Goswami, 1973) while Cecil and Pillai (1978) recommended 250 g borax/palm. However, in acute cases, this recommendation alone could not receive the full recovery of the disorder which has been experienced in the experimental field under AICRP on Palms at HRS, Kahikuchi centre. Hence, to recover the palms showing the symptoms at Kahikuchi centre, an integrated approach of application of different inputs was tried during 2016 to 2018.

Crown Choking

The incidence of this malady was first observed in 1964 in Assam and then in West Bengal. The analysis of soil and leaf samples indicated that the calcium content of affected palms showed significantly high, while the boron content was in very low concentration. Young palms of the age group of 5 to 10 years are mostly affected; however, the deficiency symptoms were not noticed in the bearing palms.

Symptoms

The first symptom is the emergence of shorter leaves with deformed and crinkled leaflets which are associated with severe tip necrosis. Those deformed leaflets fail to unfurl and ultimately give a choked appearance to the frond. Hence, this deformity of



Fig. 1



Fig. 2

the palm is called 'crown choking'. In case of young palms, peripheral leaves crowd the bud and prevent normal unfurling of the flag leaf. In acute cases, necrosis of the primordial tissue takes place and the crown dies, but not suddenly.

Remedial measures

The crown choking disorder in acute form (Fig. 1) has been observed in the eight year old nucleus seed garden of coconut (var. Kamrupa) at Horticultural Research Station, Kahikuchi under AICRP on Palms during 2015-16. With the application of borax alone to young palms, there was no recovery of the disorder. Hence attempt was made to analyse the pH of the soil. On analyzing the soil reaction it was found that it was in the range of 4.8 to 4.9. The soil of the garden was alluvial clay-loam, low in available nitrogen (236.0 kg/ha), medium in available phosphorus (23.0 kg/ha) and medium in available potassium (278.0 kg/ha) with an organic carbon of 0.45 per cent. Because of low organic carbon content coupled with low pH, palms were not recovering with the application of borax alone, hence the following remedial measures were formulated and implemented in all the affected palms for their improvement.

i. Application of dolomite ($\text{CaMg}(\text{CO}_3)$) @ 1.5 kg/palm and spraying of 0.2 % borax immediately after appearance of the symptom. (Dolomite application was repeated during second year also).

ii. Fifteen days after application of dolomite, half dose of recommended fertilizers + 100 g borax + FYM @ 20 kg per palm with additional 250 g MOP/palm has been applied to the affected palms. Subsequently spraying of borax at 0.2% was done and the practice of spraying of borax was repeated 15 days after first application. This may be done twice.

iii. The basins of the palms were mulched with



Fig. 3



Fig. 4

dried coconut leaves and the palms were irrigated by drip irrigation at 66% open pan evaporation providing 32-45 liters of water per palm per day.

Impact of the remedial measures

Each treated palm was critically observed at 30 days interval for the improvement in the disorder. The soil pH was analyzed 90 days after the imposition of treatment, and it was found that there was improvement in the pH and at the end of October 2018, it was in the range of 6.2 to 6.5. After six month of the treatment, the deformed unfurled leaflets started to make furling and new growth was observed. Eight month after adoption of remedial measures, there was complete recovery of the crown choking affected palms (Fig. 4) with normal emergence of fronds and leaflets.

The recovery of the malady might be due to the availability of boron in soil as a result of increase of soil pH to 6.5 by the application of the above treatments. Boron availability to plants decreases with decreasing soil pH especially strongly acid soil (pH less than 5.0) because of B sorption to iron and aluminum oxide surfaces of soil minerals. Balanced soil fertility along with adequate organic matter application also resulted in increase in soil carbon which has generally resulted in B uptake by plants.

Hence, from the above study it can be recommended that crown choking disorder of coconut in Assam may efficiently be corrected by soil application of dolomite @ 1.5 kg/palm, followed by (fifteen days after its application), half dose of recommended fertilizers + 100 g borax + FYM @ 20 kg per palm with additional 250 g MOP/palm. Subsequently spraying of borax at 0.2% is to be followed and the practice of spraying of borax has to be repeated 15 days after first application which may be done twice. ■

- References:** 1. Cecil, R. and Pillai, N.G. 1978. Role of boron in coconut nutrition. *Indian Coconut Journal*, 8(9): 1-3.
2. Chakravarty, B.K. and Goswami, R.N. 1973. Boron brings brighter future to coconut growers. *Coconut Bulletin*, 4(2): 10-11.

Kerala's Tender Coconut in new Avatar for Export

CDB News Bureau, Kochi

Tender coconut from the traditional coconut belt of Palakkad in Kerala has become a shining star in the export basket of coconut products. Minimal processing was the technology so far used for processing raw tender coconut for export. Since the recent introduction of Polishing Technology for processing of tender coconut, Kerala's tender nuts have become a premium and much sought after product in the export market.

Muhammed Shajahan, an young entrepreneur from Malapuram district in Kerala was exporting minimally processed tender coconut. Now he has refined the technology and the value added tender nuts processed through the Polishing Technology are being exported to various international markets.

Shajahan was working in Saudi Arabia and Dubai in computer networking for around five years. He has personally seen the high demand for minimally processed tender nut imported from Thailand in the super markets both in Saudi Arabia and Dubai.

Shajahan's product is available in many cities in Kerala. While the minimally processed nuts are having a shelf life of one month in refrigerated condition, nuts using Polishing Process are having a shelf life of seven days in open air and 15 days under refrigerated condition. The trade name of the product is Coco Tree.

A tender coconut was costing 12 Dirham (around Rs. 216) while Indian tender coconut was sold @15 dirham during those days. This was because of the better taste and higher water content of the tender coconut from Kerala especially from Attapaadi, Kozhinjampra, Meenakshipuram areas. This knowledge prompted Shajahan to start a tender coconut Minimal Processing unit. Initially he purchased two machines and started a unit attached to his house. Tender nuts were purchased from Malappuram district which were processed and exported with the export license of one his friends.

In due course, Shajahan refined the very concept of Minimal Processing technology and started using Polishing Technology developed by a team of scientists. Only nine minimally processed tender coconuts can be packed in a single carton for export. The price of a nut is around Rs. 40. Each nut weighs around 1.200 gm whereas the nuts processed using Polishing Technology weighs only around 700 gm and nearly 50 nuts can be accommodated in a single carton for export. These nuts cost around Rs. 95 per nut. The cartons are packed and exported in iced thermocol boxes. This poses the advantage for the unit to export 50 nuts at the cost of packing and sending only nine nuts.





Shjahan is presently procuring tender nuts from the farmers of Plakkad district. He has employed two agents for purchase who personally visit the gardens and purchase the nuts directly from the farmers. The nuts are brought to Bangalore for doing the Polishing process. The processed nuts are directly sent from Bangalore to various destinations. The first plant at Melattor was set up by investing around Rs. 15 lakhs and the new plant at Bangalore was set up at a cost of around Rs. 60 lakhs. Tender coconuts are brought to the processing unit on a large scale from Maddur, Pollachi etc.

The technology of polishing is developed by 'Niranthara' with the expertise of a team of scientists and this is the only unit using the technology. The processing is done at the unit for other tender coconut units also against a nominal service charge. Shajahan is willing to offer his services from procurement to processing and also export to other interested entrepreneurs.

Usually seven to eight month matured nuts are used for Polishing Process. Unfortunately most often the purchased tender nuts are more mature with which the processing cannot be done successfully. Such nuts are sold as raw tender nut itself.

Presently Shajahan is exporting the processed nuts to Oman and is planning to export to Dubai now. Shajahan's product is available in many cities in Kerala. While the minimally processed nuts are having a shelf life of one month in refrigerated condition, nuts using Polishing process are having shelf life of seven days in open air and 15 days under refrigerated condition. The trade name of the product is Coco Tree and the products are traded under the license of Tash Exin Co.

Tender coconuts purchased directly from the farmers are brought to his unit in Bangalore in 12 hours time. Initially the nuts are thoroughly washed



and then the outer cover fibre is completely removed with the help of an automated machine. Later on the nuts are dipped in a chemical solution for 7-8 minutes as is done in the case of minimal processing which is for keeping the original colour of the nut. Then a three layer padding is done with polythene paper, thermocol net and plastic net and is labelled and packed in thermocol boxes filled with ice. The product is ready for sale both in the domestic and export market. Apart from Kerala, Coco Tree products are marketed in Tamil Nadu, Uttar Pradesh, Rajasthan and Delhi.

Shajahan is planning to set up a new plant in Kerala soon. He is available @ 9048799800 ■

India's pride - Grow Spices



Read & Advertise in

INDIAN JOURNAL OF ARECANUT, SPICES AND MEDICINAL PLANTS

A quarterly publication in English having wide circulation among farmers, extension and research workers, exporters, industrialists, etc.

Popular and scientific articles on agronomy, plant protection, processing and marketing aspects with profuse illustrations, market review, price statistics, farm operations etc. etc.

Subscription Rates

Inland (4 issues)	₹ 150.00
Single copy	₹ 40.00
Three years	₹ 400.00
Foreign (4 issues)	US \$ 20.00
Single copy	US \$ 5.00

Advertisement tariff rates

	Per insertion	Four insertions
Back cover(B&W)	1500	5000
Colour	3000	10000
Inside Cover(B&W)	1250	4000
Colour	2000	7000
Ordinary page (B&W)	1000	3000
Colour	1500	4000

Subscription may be sent to the Director, Directorate of Arecanut and Spices Development, Calicut-673 005, by Money Order or Demand Draft drawn in favour of the **Pay and Accounts Officer, Deptt. of Agri. & Cooperation payable at the State Bank of India, Treasury Branch, Ernakulam.**

Director

Directorate of Arecanut and Spices Development

Department of Agriculture, Co-operation & Farmers Welfare
Ministry of Agriculture & Farmers Welfare, Government of India
Calicut-673005, Kerala, India

Telephone: Office- 0495-2369877, Director- 2765501, Fax- 0495-2765777, E-mail: spicedte@nic.in
website: www.dasd.gov.in

Chairperson, CDB visited DSP Farms and Coconut Processing Units

Smt. Usha Rani IAS, Chairperson, Coconut Development Board visited DSP Farms of the Board at Neriyaamangalam, Kerala and Vegiwada, Andhra Pradesh. She also visited CDB Institute of Technology at Alwaye, Kerala, M/s. Enbee Exim, VCO manufacturing unit and M/s. Indo German Carbons, activated carbon unit at Kochi.



1a



1b



2



3



4a



4b

1(a,b) DSP Farm, Neriyaamangalam
2 Enbee Exim

3 Indo German Carbons
4(a,b) DSP Farm, Vegiwada

Maha Shivrathri Mela 2019

Coconut Development Board, DSP Farm, Singheswar, Madhepura participated in the Maha Shivrathri Mela from 4th March 2019 to 13th March 2019. Board's stall was inaugurated by Shri. Sanjay Singh, Superintendent of Police, Madhepura. The programme was attended by Shri K K Singh, Executive Officer and Shri Ajit Kumar, Block Officer along with officials, Government of Bihar, CDB and other distinguished guests.

Various coconut products like desiccated coconut powder, virgin coconut oil, honey, jaggery, chutney powder, sweets, medicated coconut oil and coconut wood handicrafts were showcased in the exhibition along with informative charts, posters and publications of the Board and coconut bunches of different varieties. More than fifteen thousand people visited the mela and CDB received many enquiries regarding the availability of coconut products. The visitors were informed about the planting and management of coconut seedlings and also about disease and pest management of the crop. Leaflets on coconut cultivation and coconut products were distributed. The exhibition ended on 13th March 2019.



Cultivation practices for coconut -May

Summer ploughing

Ploughing of interspace of coconut gardens can be taken up depending up on the receipt of summer showers.

Sowing of green manure seeds

- Wherever sufficient pre monsoon showers are received sowing of green manure seeds can be taken up towards the fag end of May. Sowing of green manure crops like Sunhemp (*Crotalaria juncea*) or Daincha (*Sesbania aculeate*) or Cow pea (*Vigna unguiculata*) or Wild Indigo (*Tephrosia purpurea*) can be done. In the interspace of coconut gardens under monocropping the following seed rate of green manure seeds is recommended.

Sunhemp – 20 kg/ha

Daincha – 30 kg/ha

Cow pea -25 kg/ha

Wild Indigo – 15 kg/ha

If intercrops are grown, seeds of green manure crops can be sown in the coconut basin of 1.8 m radius. For Cow pea and Daincha seed rate per basin is 100g while for other green manure crops 75 g seeds can be sown per basin.



Nursery management

Continue irrigation for the seedlings in the nursery until rains set in to provide sufficient moisture. Similarly, if rainfall is not received spray water on the lower surface of leaves of seedlings

against spiralling white fly attack. Weeding has to be done wherever necessary. Land preparation is to be done for raising nursery beds.

Making pits for planting

Wherever new planting or gap filling of coconut seedlings are proposed dig pits of size 1m x 1m x 1m for planting. In laterite soils common salt can be applied to the pit @ 2 kg per pit for facilitating proper weathering of the soil. In such areas the pit size can be 1.2 m x 1.2 m x 1.2 m. Two layer of coconut husks can be spread at the bottom of the pit with concave surface up before filling the pit with soil up to 50 -60 cm for moisture conservation.

Generally the recommended spacing is 7.5 m x 7.5 m. However, wherever inter/mixed cropping is to be taken up coconut seedlings are to be planted at a wider spacing of 8-10 m.



Application of fertilizers

If pre monsoon showers combined with early onset of south west monsoon is experienced one third of the recommended dose of chemical fertilizers can be applied to the coconut palms under rainfed situation in the last week of May.

Application of 500 g N, 320 g P_2O_5 and 1200 g K_2O per palm per year is generally recommended for adult plantations. To supply one-third of the above nutrients it is necessary to apply about 0.36 kg urea, 0.5 kg rock phosphate (in acidic soil) or 0.7 kg Super Phosphate (in other soils) and 0.7 kg of Muriate of potash (MOP). After the receipt of summer showers, one-third of the recommended dose of fertilizers may be spread around the palms within the radius of 1.8 m and forked in. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided.



Application of soil amendments

In soils with acidic nature ($pH < 7$), in addition to the recommended level of fertilizers, 1 kg of dolomite or 1 kg of lime may be applied per palm per year and gypsum can be applied in alkaline soils ($pH > 8.5$) @ 1 kg per palm. Lime/dolomite/gypsum may be broadcasted during April - May in the coconut basins of 1.8 m radius and incorporated into the soil by forking. These soil amendments should be applied at least 15 days before the application of chemical fertilizers.

Irrigation

Irrigation has to be continued in coconut gardens until sufficient pre monsoon showers are received.

Pest and disease management

The month of May initiates with dry phase and during the latter phase the South-West monsoon could set in South India. Dryness of summer is so acute during 2019 and therefore sporadic outbreaks of invasive whiteflies and coconut eriophyid mites could be observed in several regions. Coconut palm not only needs water for its survival but also fills in nut water for quenching thirst for millions of mankind.

Any moisture deficit situation could drastically affect the health status of palms as well and could aggravate problems due to pest invasion. The transition to wet period is very crucial for prophylactic treatment of crown cleaning, leaf axil filling with neem cake plus sand as well as application of 1% Bordeaux mixture. If timely prophylactic measures are attended, upsurge of monsoon pests and diseases could be effectively tackled. This period thus marks the beginning of all prophylactic treatments and the age-old practices still turn appropriate and relevant in the changing climate condition. Summer period could dominate with invasive whiteflies and this could significantly be suppressed in the monsoon time. The key pests and diseases of monsoon period would be discussed hereunder.



Leaf and inflorescence damage

Rhinoceros beetle (*Oryctes rhinoceros*)

Being a ubiquitous pest, the incidence of rhinoceros beetle is quite common during all period. However its damage is well felt during the planting season of coconut. Furthermore, coconut seedlings planted during May-June should be customarily shielded from pest incursion during this period. More than 0.5% natural incidence of *Oryctes rhinoceros nudivir* (OrNV) was recorded in Peninsular India and therefore the OrNV-insensitive Coconut Rhinoceros Beetle-Guam (CRB-G) strain is not prevalent in our country, as this strain is taking a great toll in South-East Asian region causing great concern among International community making extensive damage. The pest invading juvenile palms and nuts is of greater concern these days. Moreover, the attack by rhinoceros beetle would invariable incite egg laying by red palm weevil as well as entry of bud rot pathogen

► Management

- Prophylactic treatment of top most three leaf axils with either botanical cake [Neem cake/marotti cake/pongamia cake (250 g)] admixed with



Shielding by fish net

equal volume of sand or placement of 12 g naphthalene balls covered with sand.

- Routine palm scrutiny during morning hours along with brushing of teeth and hooking out the beetle from the infested site reduces

the floating pest population. This strategy could reduce the pest population significantly.

- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.

- Dairy farmers could treat the manure pits with green muscardine fungus, *Metarhizium anisopliae* @ 5 x 10¹¹ /m³ to induce epizootics on the developing grubs of rhinoceros beetle. Area-wide farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.



Metarhizium infected grub

- Incorporation of the weed plant, *Clerodendron infortunatum* in to the breeding pits caused hormonal irregularities resulting in morphogenetic transformational aberration in the immature stages of the pest.

- Crop diversity induced by intercropping and ecological engineering principles would disorient pests and provide continuous income and employment as well.

Red palm weevil (*Rhynchophorus ferrugineus*)

Reduction in the incidences of rhinoceros beetle, would subsequently suppress the invasive potential of the killer pest, viz., the red palm weevil, which needs an injury for the weevils to orient towards the palm cue and lay eggs. Dwarf genotypes and palms aged between 5-15 years are relatively more susceptible. All life stages of the pest were noticed



Adult weevils

inside the infested palms. Being a fatal enemy of palms, 1% action threshold has been fixed. Correct geometry is very crucial for accommodating intercrops as well as pest avoidance due to multiple odour cues.

► Management

- Field sanitation is very critical and all residual population in crown toppled palms should be destroyed

- Avoiding palm injury is very critical to disorient the gravid weevils away from the field and therefore leave out at least one metre from palm trunk when petioles are cut.

- Crop geometry and correct spacing is very crucial to reduce pest attack.

- Timely and targeted spot application of imidacloprid 0.002% (1 ml per litre of water)



Toppling of palm

or indoxocarb 0.04% (2.5 ml per litre of water) on infested palms would kill the feeding grubs and induces recovery of palms by putting forth new spear leaf.

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



Crown entry

Diversified cropping system reduces pest incidence than mono-cropping.

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

It is commonly observed on palms affected by root (wilt) disease wherein foliar necrosis of terminal spear leaf and adjacent leaves are registered. The disease is prominently noticed in the post-monsoon



Leaf rot disease in juvenile palm



Bud rot affected palm

phase during the month of December. Affected leaves turn necrotic and are not detachable from the palm and remain intact. This disease could be initially observed as minute lesions which later enlarge, coalesce and cause extensive rotting affecting the photosynthetic efficiency of palms. The disease is endemic to root (wilt) affected regions of Southern Kerala.

► **Management**

- Need based pruning and destruction of disease affected regions of spear leaf and other adjacent leaves in the terminal region
- Spot application of hexaconazole 5 EC 2 ml in 300 ml water on the affected spear leaf region

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

In certain humid locations bud rot occurred regularly killing hundreds of trees. In India, bud



Withering of spear leaf

rot incidence is recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or

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

► **Management**

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

Timely prophylactic application would equip palms to withstand the pressure of pest and diseases during monsoon period. As the adage says ‘Prevention is better than cure’ so should be our approach to avoid invasion by pest and diseases rather than seeking strategies for curing. ■

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

Market Review – March 2019

Domestic price

Coconut Oil

During March 2019 the price of coconut oil opened at Rs.17200 per quintal at Kochi, Rs.17300 per quintal at Alappuzha and Rs.17700 per quintal at Kozhikode market. During the month, price of coconut oil at all three markets expressed an overall downward trend though by the fag end of the month prices depicted a slight upward trend.

The price of coconut oil closed at Rs.16300 per quintal at Kochi and Alappuzha market and Rs.16700 per quintal at Kozhikode market with a net loss of Rs.900 per quintal at Kochi, Rs.1000 per quintal at Alappuzha market and Kozhikode market.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.13667 per quintal, expressed a similar trend as that of coconut oil price in Kerala and closed at Rs.12667 per quintal with a net loss of Rs.1000 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01/03/2019	17200	17300	17700	13667
10/03/2019	16800	16800	17350	13333
17/03/2019	16400	16500	16850	12667
24/03/2019	16100	16200	16600	12333
31/03/2019	16300	16300	16700	12667

Milling copra

During the month, the price of milling copra opened at Rs.11100 per quintal at Kochi, Alappuzha and Kozhikode market. The price of milling copra at all three markets expressed an overall downward trend though by the fag end of the month prices depicted a slight upward trend.

The prices closed at Rs.10200 at Kochi market, Rs.10100 at Alappuzha and Rs.10450 at Kozhikode markets with a net loss of Rs.900 per quintal at Kochi, Rs.1000 per quintal at Alappuzha market and Rs.650 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices opened at Rs. 9900 per quintal and closed at Rs.9000 per quintal with a net loss of Rs.900 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
01/03/2019	11100	11100	11100	9900
10/03/2019	10700	10600	10850	9500
17/03/2019	10300	10300	10400	9100
24/03/2019	10000	10000	10250	8800
31/03/2019	10200	10100	10450	9000

Edible copra

The price of Rajapur copra at Kozhikode market which opened at Rs. 15600 per quintal expressed a downward trend till third week of the month. Thereafter price expressed a slight increasing trend closed at Rs.16200 per quintal with a net gain of Rs.600 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01/03/2019	15600
10/03/2019	15200
17/03/2019	14600
24/03/2019	14500
31/03/2019	16200

Ball copra

The price of ball copra at Tiptur market which opened at Rs.16500 per quintal expressed an overall downward trend during the month, but closed at Rs.16500 per quintal with an upward trend by the end of the month.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
01/03/2019	16500
10/03/2019	16500
17/03/2019	16100
24/03/2019	16000
31/03/2019	16500

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.7300 per quintal expressed a downward trend except the last week of the month. The prices closed at Rs.7500 per quintal with a net gain of Rs.200 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01/03/2019	7300
10/03/2019	7300
17/03/2019	7200
24/03/2019	7200
31/03/2019	7500

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.18000 per thousand nuts and closed at Rs.15000 per thousand nuts during the month. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.14000 per thousand nuts and closed at Rs.12000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs.15000 and closed at Rs.20500 per thousand nuts.

Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Pollachi	Banglore
01/03/2019	18000	14000	15000
10/03/2019	16000	13000	20500
17/03/2019	15000	13000	20500
24/03/2019	15000	12000	20500
31/03/2019	15000	12000	20500

International price

Coconut oil

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

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US\$/MT)	Domestic Price(US\$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philippines	Indonesia	Sri Lanka	India*
02.03.2019	694	697	705	1805	1962
09.03.2019	695	685	682	1818	1914
16.03.2019	670	657	662	1818	1866
23.03.2019	686	685	690	1825	1771
30.03.2019	665	673	684	1842	1818
* Kangayam					

Copra

The domestic price of copra at Philippines and Indonesia expressed a mixed trend during the month while a downward trend was noticed in India and an increasing trend in Srilanka. The price of copra quoted at different domestic markets is given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
02.03.2019	419	390	990	1421
09.03.2019	417	391	995	1364
16.03.2019	412	379	998	1321
23.03.2019	412	413	1001	1263
30.03.2019	414	379	1011	1292
* Kangayam				

Coconut

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

Weekly price of dehusked coconut with water				
Date	Domestic Price (US\$/MT)			
	Philippines	Indonesia	Srilanka	India*
02.03.2019	119	141	170	424
09.03.2019	118	142	166	409
16.03.2019	116	142	170	395
23.03.2019	116	145	167	373
30.03.2019	111	140	169	380
*Pollachi market				