Index

Message from the Chairperson's Desk

Dear readers,

Hearty Greetings from Coconut Development Board!

Coconut Development Board in the financial year 2019-20 will be focussing very high on area expansion on cluster basis, strengthening of its DSP Farms to produce quality seedlings, market support to the farmers and also conducting training programme to the farmers.

As we all know the coconut is a promising commercial crop as a number of value added products can be made from coconut. The Board has been working in its endeavour to develop new products in collaboration with prestigious research institutes like Central Food Technology Research Institute (CFTRI), Central Plantation Crops Research Institute (CPCRI) and Indian Institute of Food Processing Technology (IIFPT). Farmer is the centre of the activities of Coconut Development Board. The coconut farmer need to be well informed about the marketing prices and improved agronomic practices. A detailed plan has been proposed during the current year to reach out to the majority of farmers especially all the members of CPS, CPF and CPC. A strong IT based knowledge platform is being worked out to reach every farmer directly.

The importance of entrepreneurs cannot be undermined as they are creating marketing opportunities to the farmers. All the pending proposals with Coconut Development Board have been scrutinized and action is being taken under the Technology Mission on Coconut to support entrepreneurs. The coconut farmer do face vast challenges from many exotic pests and diseases. A proposal is being worked out in association with the University of Agricultural Sciences, Raichur, Karnataka to address the pests and disease problems on pilot basis in Karnataka State. Coconut Development Board with its committed staff is planning to reach every farmer and also in collaboration with scientists, State Governments and Central Government.

Nothing is impossible if the employees of any organization are motivated and committed. Systems are kept in place to prevent misuse of public money and to ensure transparency in implementation of the schemes by introducing Direct Benefit Transfer(DBT) to the farmers as per the vision of Government of India. In the new financial year let us work more hard and utilize budgets properly for the benefit of farmers so as to keep Indian farmer at an esteem position in the international arena in coconut sector.

V Usha Rani IAS

Chairperson

Produce quality seedlings to satisfy the expectation of farmers

Jnanadevan.R
Deputy Director, CDB, Kochi - 11

The expectation of every farmer while purchasing coconut seedlings for planting will be that it should be early bearing, high yielding, should be of short stature etc. If poor quality planting materials are used for planting, the performance of the palm will not satisfy the expectation of the farmer causing considerable loss of time and money to the farmer. In the absence of commercially viable vegetative propagation techniques, only seed propagation is possible in coconut. But planting seed nut directly in the plating pit is not recommended because it will not facilitate all the desirable qualities of a good quality seedling. The desirable qualities are controlling by the genes present in 32 chromosomes in each cell of coconut palm which is transferred from generation to generation through seeds. The quality of coconut seedlings, (i.e. the ratio of the performance of seedling in the field and the expectation of farmers) is highly correlated with mother palm characters. Selection of high yielding mother palms and practice of raising seedlings in the nursery is essential to produce good quality seedlings. It is possible to improve the quality of the planting materials through a series of selections at various levels of seedling production. For production of quality coconut planting material it is essential to have good seed gardens and quality mother palms of the desired varieties. The present scientific approach recommended is to select seed parents or mother palms in selected blocks based on yield and other

Selection of high yielding mother palms and practice of raising seedlings in the nursery is essential to produce good quality seedlings. It is possible to improve the quality of the planting materials through a series of selections at various levels of seedling production.

desirable characteristics followed by seed nut and seedling selection.

In Srilanka, it was observed that by mother palm selection alone 50% quality efficiency can be achieved and it could be raised to 90% by planting selected seedlings obtained from the palm.

In Kerala there was a custom to set apart selected palms as seed parent by traditional farmers in earlier days. Short statured palms which produce large number of big to medium sized nuts without exhibiting irregular bearing were selected as seed parents. Bunches of 12 month old were cut and brought down with the aid of rope. Seedlings were produced in every year in nursery beds maintained in home gardens. Early germinated vigorous seedlings thus produced were selected and used for under planting and new planting. This system was discontinued by young generation in the state. Mother palm selection and selection of seedlings in the nursery stage at different levels are a key factor in planting material production of coconut. Production and management of planting material in the nursery decides the performance coconut in the field.

This article provides information on some of the most important aspects of coconut nursery management and the important points to be considered while purchasing good quality seedlings.

1. Select the right location for coconut nursery

The land should be flat or with low gradient. The soil should be loose and friable with adequate drainage and irrigation facilities. Sandy and sandy loam areas with well drained soil are the best location. Prepare raised beds if water stagnation is a problem during rainy season. Nursery can be raised either in the open with artificial shade or in interspaces of coconut gardens where the trees provide shade. Under heavy shade seedlings tend to become lanky. Ensure sufficiently trained manpower to carry out nursery operations at the site.

2. Collect seed nuts from superior mother palms

Mother palm slection is a key factor in planting material production of coconut. It should be done with great care on them basis of the following procedures. Palms selected should have reached full bearing stages and have been giving consistently high yields for at least four years. Avoid very old palms of above 60 years age. Palms which produce barren nuts or those shedding large number of immature nuts should be discarded. Collect seed nuts from January to April in the West Coast region. Only fully matured nuts i.e. about 12 months old should be harvested. Nuts should not be damaged while harvesting. Discard nuts having irregular shape and size.

Select individual palms from identified garden based on desirable agronomic features as mentioned below.

Quality Standards of Tall Mother Palms
Regular bearing yielding 80-100 nuts per year
Stout Strait trunk with closely spaced leaf scars
Age- 15 to 50 years
Steady bearing palms also can be selected as mother palms irrespective of age
More than 30 fully opened leaves with short strong petioles and wide leaf base firmly attached to the stem. Leaf orientation should be in all direction . ie, umbrella shaped
Bearing at least 12 bunches of nuts with short and strong bunch stalks. Bunches of medium sized nuts in sufficient numbers.
Quality Standards of Dwarf Mother Palms
High yielding with above 60 nuts/tree/year
Age 8 to 30 years
Steady bearing palms- irrespective of age
26-28 opened leaves with short strong petioles and wide leaf base firmly attached to the stem.
Bearing at least 12 bunches of nuts with strong bunch stalks
Possess all typical characters of dwarf with regard to stem, crown, nut and inflorescence. The girth of the stem will be less compared to tall. The width of the leaflet will be considerably narrower than tall.

3. Adopt right time and method of sowing of seed nuts

The proper time for sowing nuts in the nursery will vary from tract to tract depending upon the monsoon. By sowing at the time of monsoon it will be possible to avoid heavy and frequent watering required for good germination. May- June is the best time for sowing seed nuts in the nursery in the west coast region. Seed nuts should be sown in raised beds at a spacing of 30cm between nuts in rows and 40 cm between rows. Normal size of nursery bed should be to accommodate 5 rows and the length of the bed can be as desired in order to facilitate routine activities. Each nursery beds are with a spacing of 60 cm apart.

Seed nuts are sown in the nursery either vertically or horizontally in 20-25cm deep trenches. At the time of sowing, seed nuts are to be checked and nuts in which water has dried up should be discarded. Advantage of vertical planting is that there will be less damage during transit. However, in delayed sowing when the nut water goes down considerably it is good to go for horizontal sowing for better germination. Horizontal sowing with widest of three segments of seed nuts placed upper most has been reported to give a higher percentage early and total germination and vigorous seedlings with thick collar girth. Studies conducted at Papua New Guinea reported that the rate of germination and subsequent growth of seedlings were much faster in horizontal sowing than in vertical sowing. It is advisable to have horizontal sowing when we raise nursery in small scale for home garden requirements. A sign board should be placed in front of each nursery bed providing information viz; name of variety/ cultivar, date when nuts were harvested, date when nuts were received in the nursery, date of sowing, number of seeds nuts sown, seed bed number etc.

4. Use fully matured nuts only as seed nuts

Selection of fully matured nuts is very important in coconut seedling production. Germination of seed nuts and quality of seedling produced has got a direct bearing maturity. Germination and vigor of seedlings depend very much on quantity and quality of kernel in the nut. Eleven to twelve months is the standard maturity time for selection of seed nuts. Mature nuts will produce a resonant and ringing sound on tapping which can be identified by experience Imature nuts will produce a dull sound. Under matured nuts should not be used as seed nuts as it produce low quality seedlings only.

5. Remove all non-germinated nuts from the nursery timely

All non germinated nuts should be removed at the end of six months from sowing. In a well managed nursery at least 80% of seed nuts should have been germinated by this time. Recommended standard for sprouting period is up to six months after sowing.

6. Raise seedlings in Poly bags for early flowering

Vigorous seedlings could be prepared by this method. For this germinated seed nuts are transplanted in poly bags of size 60 x 45 cm with 8-10 holes at the bottom. The potting mixture is in the 2:1:1 ratio of topsoil, sand and compost mixture. The advantage of poly bag seedlings is that there is no transplanting shock and the seedlings are with better vigor. But the disadvantage is the increased transportation and seedling cost.

7. Select only good quality seedlings from the nursery

Selection of seedlings from the nursery is an important step for ensuring high yield. Only seedlings

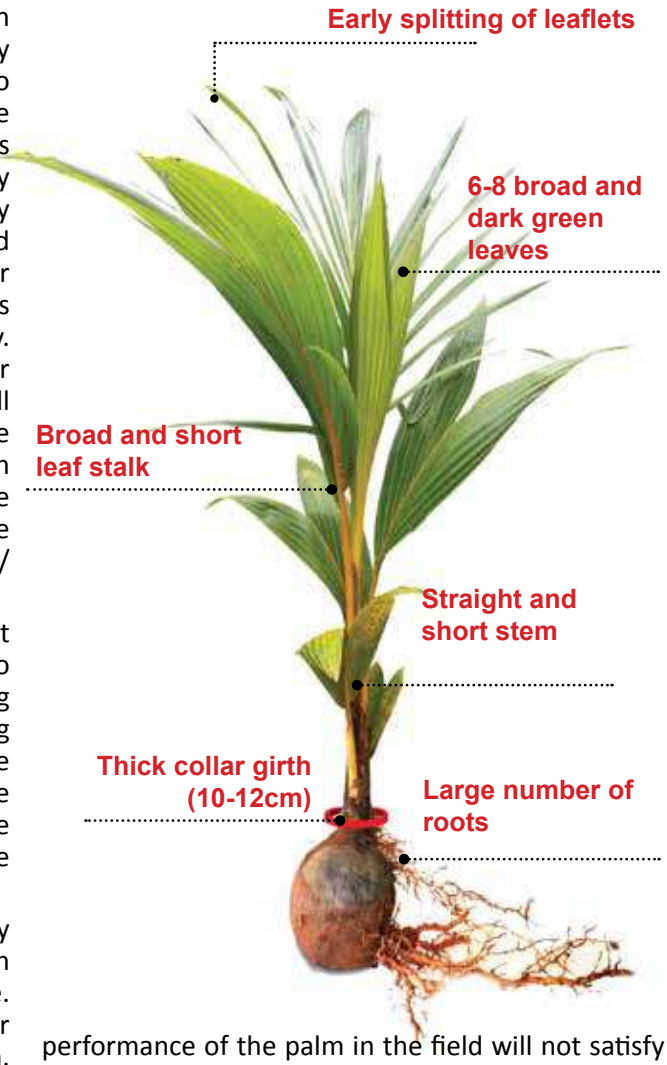
with good quality should be selected through a rigorous selection based on characteristics viz: early germination, rapid growth and seedling vigor, six to eight leaves with short and stout leaf stalk, with thick collar girth and early splitting of leaves. Early germination is an important factor to be taken in to account in the selection of good seedlings from the nursery. Early germinated nuts produce seedlings giving a faster rate of leaf production and early flowering. The vigor of the seedling is indicated by healthy leaves with early splitting, short and broad leaf stalks with good girth at collar region. The collar girth is one of most important quality parameters insisted while selecting seedlings from the nursery. This will wary from 5cm to 20cm and minimum collar girth for qulity seedlings should be 10-12 cm for Tall and 8-10 cm for dwarf. The color of the petiole of the seedling leaf can also be used as a selection criterion for dwarfs and hybrids. The dwarfs should exhibit the petiole colour of the mother palm while, the petiole colour of hybrid seedlings may range from green/ brown/intermediate shades of the parents.

There are no serious pest and diseases in coconut nurseries. However, bud rot affected seedlings are to be avoided for planting. The symptoms are yellowing and withering of the spindle leaf followed by drying and death of the seedlings. The spindle of the affected seedlings will easily come out with a gentle pull and rotting can be seen in the lower end of the detached spindle. Seedlings that do not meet the above criteria should be discarded.

The first selection of seedlings from the nursery should be made six months after sowing and all non germinated nuts should be removed at this stage. The rest of the nuts even if they germinate under favourable condition will result in poor growth. Hence it will not be at use to keep such nuts in the nursery. A second selection is done 7-8 months after sowing and all non-vigorous poor quality seedlings should be removed. In a well managed nursery the rejections should be kept @ 30-35 % (non-germinated 8-10%, late germinated 10-12 %, and low quality 12-15 %) In a well managed coconut nursery recovery of good seedlings selected, based on the above characteristics will be 60 to 65% of the total seed nuts sown. All rejected seedlings ie, 35 to 40% should be removed before sale.

There should be greater emphasis in popularizing the importance of using quality planting material in coconut production and quality parameters for selection of mother gardens, seed nuts and seedlings. If the quality seedling used for plating is poor the performance of the palm in the field will not satisfy the expectation of the farmers causing considerable loss of time and money. Hence while producing seedlings the quality parameters explained above shall be strictly followed.

Recognized Standards for Selection of Vigorous Seedlings



Procurement of seed coconut by farmers and raising seedlings by observing quality parameters fallowed in earlier days by traditional farmers of Kerala should also be promoted to meet their requirements. This will help to reduce transportation cost and ensure better availability.

There should a very strong farmer and nursery owners awareness building programme on the quality parameters for selection of mother palm and quality seedling production by professional group continuously. Put in visual, audio and print media also in the awareness programmes ■

Get set go
Here begins the real NEERA revolution

Sona John, CDB, Kochi - 11

No more frequent climbing of tappers, no sharp knives, no tying of bunches, nothing. Just climb the palm once, install the Saper on to the crown of the palm to the inflorescence and then the neera or toddy will reach the container installed on the ground through the pipeline attached to the Saper on the tree.

This innovative robotic Saper is designed and developed by Nava Design and Innovation Pvt Ltd. a Kochi based start up. A prototype of this equipment was displayed in the Hardtech Conclave held in Kochi during April 2019.

Shri. Charles Vijay Varghese, a young engineer based at Kochi is the inventor of this high tech Saper. If you install the machine in the crown of a coconut

The prototype of a robotic Saper to tap toddy and neera without climbing the palm every day is ready now. The prototype of the robotic Saper is designed and developed by Nava Design and Innovation Pvt Ltd. based at Kochi. The response being received for the Saper is quite encouraging. Even foreign companies are sending their people to Kochi to review the working of the Saper in person and then to place order.

palm attached to the inflorescence to be tapped, neera or toddy can be tapped and the details of the neera produced from the same will be received in the mobile phone of the farmer from time to time through the mobile application using Robotic Internet of Things.

This robotic tapping machine is the result of the fervent and tireless efforts of this team for more than one and a half year. This Saper lessens the effort of the tapper. The machine is doing the same job and can collect neera produced from one or two acres in a single collection point. Charles claims that the Saper has a life span of five years. During this period a tapper has to climb the tree for around 5400 times whereas when the Saper is installed the farmer has to climb the tree only 40 times which explicitly makes it clear that the burden of the tapper or the farmer is reduced drastically.

It was in 2015 while working in the Gulf that Charles came to know from media about the issues faced by the neera tapping sector. Even before that Charles had personally seen the constraints of the toddy tappers who used to tap toddy from the premises of his house in Kochi. The idea of designing a machine was there in his mind since then.

His engineering background as well as his inborn talent in drawing was the added advantages in developing the design of the machine. He remembers that he used to draw the sketch of the machine several times while he was in Gulf. It went on for more than four years and finally he decided to quit his job and then to pursue his career with the machine. Eventhough the concept was not encouraged by people around him, but was not opposed. The application for the provisional patent for the Saper in the name of Nava Designs was filed in 2016 and was granted in 2017. Charles was a single army during those days and his team mates joined him when the idea was finally about to consummate. Charles, a graduate in Electrical and Electronics Engineering is the CEO of the company. His wife Ninu, his young engineer friends, Vinu, Sujith, Anup, Manu, supervisor Jithin and the tapper Sukumaran are his team members.

From the very beginning, the trials in designing the machine were done in the crown of a 40 feet high coconut palm in the backyard of Charles's house in Alwaye. A 40 feet high strong platform with scaffoldings was made initially with which all the six engineers could easily climb and stand on top. Sukumaran would also be there with the team from whom they learned about the nature of the crown, the character of the inflorescence and also on how to tap neera. Apart from Sukumaran, Bhaasi and Suresh also helped the team to equip themselves.

It was in 2017 July that he registered the start up in the Maker Village in KINFRA, Kochi and then filed the application for full patent. Both the Indian patent and international patents were received during the year. Further he has filed patent applications in another 12 coconut growing countries also.

The designing of the machine was started after

> **Saper has a life span of five years. During this period a tapper has to climb the tree for around 5400 times whereas when the Saper is installed the farmer has to climb only 40 times which explicitly makes it clear that the burden of the tapper or the farmer is reduced drastically.**

a detailed study on coconut inflorescence and the proof of concept was completed in July 2018. The device has multiple mechanisms to mimic every action of a traditional tapper. The device is solar powered and has an in-built programmed controller to activate different mechanisms at specified time and the mobile application has all feedback and controls. A vacuum extractor at the ground level evacuates neera from the device and transfer it to a storage via drop line tubing connected to the device.

The proof of concept was designed and the initial trial was done in the coconut gardens in Govindapuram in Palakkadu district in Kerala which was a success. Now Charles is all set to rectify the minor drawbacks of the prototype in the final product and then will go for mass production. The team Nava Design and Innovation Pvt Ltd is planning the commercial production of the machine in a year's time.

Initially Charles had to struggle for the capital. The savings he made from his job was utilized and a loan was taken from the bank. Kerala Start Up Mission and Bharath Petroleum also extended their helping hands. Charles gratefully acknowledges that this mission wouldn't have been successful without the help of all these agencies.

Charles claims that various trials have proved that the tapper productivity multiplies by minimum 72 folds with the use of his Saper. The same inflorescence can be tapped for a maximum period of three months or more since the adverse climatic conditions doesn't affect the functioning of the Saper.

Charles ensures that the equipment doesn't need any repair for a minimum period of five years. Only the blade and the Lithium Polymer (LiPo) battery need to be replaced. Once the commercial scale production of the Saper is started, the cost of the Saper can be limited between Rs. 7000 - 15000 or US$ 100-200 says Charles.

Even though many favourable factors are there for the future prospects of the Saper, adversities like Excise laws for the neera production Licensing to the farmers may shadow his future prospects.

Charles, son of C A Vargese and Thankamani who hails from Alwaye in Kerala took his B tech from M Kumarasamy Engineering College in 2005 and PG in 3D Design from Chennai. Further to that he was working in Gulf for a decade and his last job was the Assistant Unit Manager at Khimji. He has a 6 month old daughter Natasha.

For further details contact: NAVA Design & Innovation Pvt. Ltd , Maker Village, KITZ, KINFRA, Hi-Tech Innovation Park, Kalamassery, Kochi - 683 503 India +91 88485 06173, https://navainnovation.com, email:info@navainnovation.com ■

Participatory Technology Delivery mechanisms for coconut farming communities-

Experiences and lessons

Anithakumari. P*., Shanida Beevi#, Thejaswibhai# and Priya K Nair#

* Principal Scientist, ICAR CPCRI, Regional Station, Kayamkulam

Department of Agricultural Development and Farmers Welfare, Kerala

Coconut farming provides livelihood, nutrition, beverages, edible fat, ecological services and contributes to the state economy. The challenges of extension support, services and technology delivery and dissemination are the fragmented landholdings among coconut community and the number of farmers to be covered under wider agricultural extension umbrella. The field issues and constraints are expected to be individual and social based as well as resource base of the farmers. Technologies and practices are applicable in general across the community, but warrants delivery and extension mechanics specific to technology, crop or field problem for effective adoption by farmers.

Appropriate extension approaches for doubling farm income

Extension approaches had very crucial role in improving technology utilization, augmenting effectiveness of agricultural extension in technology dissemination, equitable access to stakeholders, refinement and participatory adaptation of technologies to suit resources and specific situations and thus paving strong and sustainable foundation for doubling of farm income. ICAR-CPCRI (Indian Council of Agricultural Research- Central Plantation Crops Research Institute) evolved the following extension approaches for solving the challenges posed in economically viable extension support and services, in collaboration with state extension agencies, local self governments and farmer organizations.

1. Participatory technology transfer approach (PTTA) for root (wilt) disease affected areas (Crop / field problem specific).

2. Livelihood improvement of rural women through bio resource management (Gender dimensions in extension and income generation).

3. Clustering coconut farmers for income and livelihood for overcoming limitations of fragmented holdings and varying resource base of farmers in technology adoption

4. Area wide community extension approaches (AWCA) for bio intensive management of RB of coconut (Technology specific).

5. Community based Participatory management for red palm weevil of coconut (Crop and field problem (pest) specific).

The features of these extension approaches eventually enabled the up scaling of the social processes and innovations to other areas with a paradigm shift of units of adoption from individual farmers to a wider contiguous area or farmer clusters, thus enhancing and ensuring the validity and feasibility of technology efficiency at individual level irrespective of resource base. The major features are participation of community and relevant stakeholders, intensive, need based extension strategies (integrated) for development, awareness, knowledge, skill and adoption, evolving social process and social mechanisms for technology adoption in

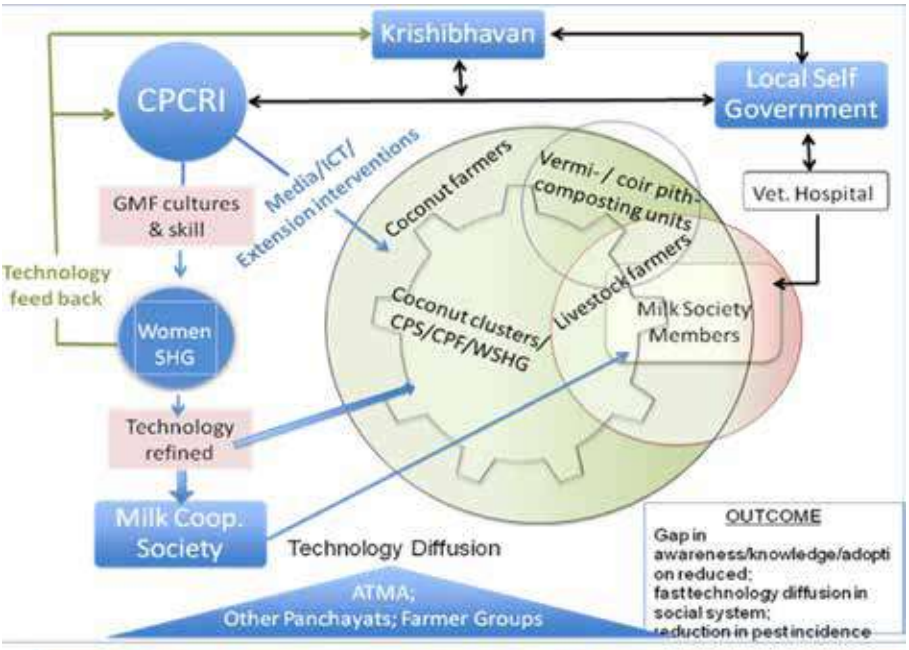


Fig.1- Community Extension Approach (AWCA) of Bio-management of Rhinoceros beetle

an area wide manner, efficiency of extension system improved and enabled rapid adoption process across society irrespective of socio personal economic inequalities.

Appropriate extension approaches ensembles inclusiveness, equity and plurality for making the process purposeful and result oriented (fig.1).

Coconut extension approaches – ICAR CPCRI experiences and lessons

Participatory Technology Transfer Approach (PTTA)

Coconut farmers faces several risks both in farming and marketing. One of the major risks was the debilitating root (wilt) disease of coconut, which is the most important factor for low productivity of palms in the disease affected tracts. The PTTA is a continuous social process requiring adaptation and refinement according to localities and the farming situations. The basic simple idea evolved, was based on the low level of confidence and motivation among farmers to adopt the integrated root (wilt) disease management package of technologies recommended by CPCRI. The adoption of recommended practices by coconut farmers in a contiguous area enables triangulations among the participant farmers and relevant stakeholders on the technical effectiveness and its impact in overcoming the risk and improving yield and income. The PTTA was implemented in 25 ha of (5000 coconut palms) contiguous area, involving 208 coconut farmers in Krishnapuram Panchayath around the CPCRI Regional station, Kayamkulam. The implementation phases were rapport building and dialogues with stake holders, participatory assessment of farming situations, documentation of farm and palm profiles, technology transfer activities involving society, technology implementation or community adoption, monitoring and follow up and finally participatory evaluation, through formal and informal methodologies like participatory observations, participatory rural appraisals (PRA), interface meetings of stakeholders and impact surveys. The pilot experiment /program were implemented around the ICAR-Central Plantation Crops Research Institute, Regional Station, Krishnapuram, Kayamkulam.

The Impact

The PTTA proved the potential of people's action consolidated and collaborated with extension and research system in reducing the dissemination gap, improving yield of coconut in root (wilt) affected areas adopting the recommended management package by 91.4% with an improvement in benefit cost ratio from 1.03 to 1.77. Health of the disease affected palms as indicated by the root (wilt) disease index score, also improved with sharp reduction in the disease advanced palms from 23.5 to 7.8 after interventions and apparently healthy palms improved from 12.6 to 18.8 percent. The yield gap reduction due to adoption of management practices were 62 to 88 percent when the approach was up scaled and the management gap in yield was 142 percent between the research station yield and farmers fields in WCT palms, indicating the potential. The improvement in awareness, knowledge, attitude and adoption of the integrated root (wilt) disease management practices was statistically significant and the approach being

inculcated in most of the development programs of coconut, giving a paradigm shift in extension program implementation and technology interventions.

Table 1. Impact of integrated root (wilt) disease management practices

Yield	Pre-project	Mid-project period	End of project
Average (nuts/palm/year))	24	32 (34.3 %)	46 (91.4%)
B C Ratio	1.03		1.77

Clustering coconut farmers/ farm families

This extension approach aimed at enhancing adoption and income from marginal and small holding coconut gardens. The social process included involving the whole farm family and selection of 50-125 farm families to form a cluster, cluster initiation and group management maintaining transparency in problem analysis and prioritizing, social mapping to document social/ economical/ agricultural and common resources, documentation of farm and palm profile, extension activity plans to bridge knowledge / skill groups, procurement of common inputs and adoption through farmer cluster conveners/ young farmers' club/ women self help groups, promotion of self perpetuating practices (like, basin management with cowpea, low cost vermin composting, backyard poultry, mushroom, azolla, intensification of intercrops, coconut value addition) post training support for micro entrepreneurs and linkage facilitation with other agencies.

Impact

The utility and feasibility of farmer cluster extension approach is that, it could enable equity of research benefits to farming community irrespective of the general prevalence of heterogeneous households in a social system. The yield of palms doubled compared to pre intervention data (from 34 to 75 nuts/palm/year) and the overall income from coconut increased by 71.3 per cent and 138.6 percent from other farming system components, even from homesteads of size up to 0.1 ha. Value addition activities of coconuts in the cluster area by women groups earned an additional value of Rs.9.40 per nut. The information exchange by the farmers also supported the validity of this approach with 20.57 percent disseminated to relatives, 23.33 percent to friends and 34.3 percent to other farmers. This approach also being scaled up as feasible extension approach in doubling income from coconut based homesteads.

Area wide community extension approach (AWCA) for bio management of coconut pest

The awareness, knowledge and adoption of bio management of coconut pests were reported to be less than 2 percent. The analysis of the causes indicated that an 'all to fit' extension approach could not achieve the desired results in field situations. Hence a participatory social experiment was designed and pilot tested in Edava grama panchayath in Kerala involving 5465 coconut farmers in an area of 520 ha with 1.105 lakh coconut palms of various age.

The community approach was initiated with participatory analysis about their preferences in managing the most widely affected pest of coconut, rhinoceros beetle. The three stages of the process were involving rural women farmers to IPM technologies in off campus programmes and convincing the visibility of technology impact, secondly rural educated women groups were trained in farm level Metarhizium (fungal bio agent for treating rhinoceros beetle multiplication sites- cow dung pits, FYM pits, coir pith heaps, compost pits, decayed coconut logs, etc) production and thirdly facilitated community based adoption (treatment of all the potential breeding sites of rhinoceros beetle in the entire panchayath involving milk cooperative societies, coconut producers societies, women SHG) in the entire panchayath as adoption cum participatory monitoring and evaluation campaigns.

Impact

The category of 'critical adopters' for bio management adoption (livestock farmers, compost units, coir pith processors- total 653 numbers) in the successful management of the social process were identified and effectively completed the process in two weeks. If the critical adopters were not identified and purposefully engaged in the adoption process the technology efficiency as well as pest management could not be achieved. The entire critical adopters and the coconut farmers in general were involved and 75.8 percent reduction in fresh incidence of the pest achieved. The knowledge and awareness, on the technologies and skills, increased to 60-70 percent among the farming community due to the extension approach. The inefficiency of

Comparison of the Extension Approaches in Coconut					
Sl No.	**Extension approach**	**Period of pilot testing**	**Level of participation**	**Social paradigms**	**Area /Unit of implementation**
1	Existing extension approaches for coconut Availing benefits of schemes/ projects.	1990-2000	Passive participation (Individual approach)	Linear transfer of technology	Household level. Adoption of technologies was very low.
2	Participatory Technology Transfer Approach (PTTA)	1999-2003	Participation by consultation and participation for material benefits	Paradigm shift to contiguous area and farmers clustering, direct interaction with research institution and society, Triangulation by multiple stakeholders	Contiguous area of 25 ha with 50 to 125 farm families. Convinced policy makers & extension officials regarding the need & utility of research in improving yield &health of palms.
3	Livelihood improvement of rural women through micro entrepreneurship in bio resource management Edava Women's Association (EWA) federated 22 micro Agri enterprises of women	2007-2008	Functional participation Cost sharing Evolved model of farm level integrated value addition of produces from coconut based homesteads Gender dimensions - access of women farmers to technology improved.	Gender based collective action, location specific bio resources for EDP (Thekkekara panchayath, Alapuzha district) Gender based value chain activities, facilitating technology adoption through farm level production (FLP) of Metarhizium as well as refinement and modification of FLP resulting 40 % cost reduction.	One panchayath – groups mobilization, group action, local bio - resources of 500 ha area Focus shifted to value addition and additional farm income Reinvented gender roles in coconut farming
4	Clustering coconut farmers/ farm families	2005-2008	Functional participation Cost sharing	Farm family participation of small & marginal land holders to attain economy of scale Coconut farmers clustered and evolved through group dynamics as rural institutions for appropriate decision making and prioritization at local level	25-50 ha of contiguous area of coconut and cropping/farming systems with emphasis to integrated farming systems (IFS) and value addition
5	Area wide community extension approach (AWCA) for bio management of coconut pest	2010-2013	Interactive participation and Functional participation Improved technology access and cost sharing for technology adoption	Joint analysis, formation of farmers local institutions (clusters), systematic and structured experiential learning	500- 1000 ha (panchayath wise) Identified the critical adopters in bio management of rhinoceros beetle for effective resource management in outreach programs
6	Community based area wide participatory surveillance and adoption- Coconut Red palm weevil management	2014-2016	Interactive participation and Functional participation	Socially responsible technology delivery and facilitating adoption across the social system through joint learning	1000 – 2000 ha of coconut cultivated areas

varied adoption, discontinuation, non adoption of bio management could be bridged through this approach.

Community based area wide participatory surveillance and adoption

Coconut Red palm weevil management

Red palm weevil (RPW) is one of the pest of palms causing crop loss and farmers are concerned about the spread of the pests and the practical difficulties in managing effectively due to the concealed nature of the weevil, difficulty in identification of the pest infestation well in advance and the scarcity of climbers for pesticide application and controlling the pest. ICAR CPCRI evolved a participatory extension approach in community based management of red palm weevil which was demonstrated in 2000 hectares of coconut in Bharanikkavu gramapanchayath of Alappuzha district in Kerala.

The components of implementation were, household based pan - area survey to GPS tagging of the red palm weevil infested, with pest life stages in active stages as well as dead palms due to RPW infestation, documenting other pests and diseases and palm/farmer profiles, analyzing the spreading pattern of the pest in farmers gardens in contiguous area, involving coconut farmers/groups/ women SHG members in the survey to inculcate the surveillance procedures in scientific manner, and consensus meetings for deciding integration of technology choices and social interventions. For the implementation of the extension approach field level practical training programmes and 42 group meetings were organized for the conscientization of coconut community and general public on the process and technologies to be adopted in eco friendly manner, formulated 'Coconut plant protection and surveillance groups' (CPPSG) equipped with pesticides/ fungicides (mostly bio products), sprayers, climbing machines, ladders and protective gadgets, ward wise Integrated coconut field clinics (ICFC) and support mechanisms with stakeholder representatives from local grama panchayths, coconut producers societies and federations, rural youths, scientists, Agricultural officer/extension officials etc. An exclusive mobile number was in unction for registering the incidence of red palm weevil in coconut palms and any other field problems to be tackled by the farmers or surveillance team. The technological interventions were phytosanitation (removal of dead palms, destruction of different stages of red palm weevil in palms, leaf axil filling), crown cleaning, spot application of Imidacloprid 1 ml /liter water in infested palms, treatment of all breeding sites of rhinoceros beetle in the panchayath with Metarhizium (fungal bio agent), and nutritional management of palms.

Impact

The community based extension approach was implemented in an area of 2000 ha in 174733 palms of 7068 households during 2014 and 2015. The pest infestation was reduced @ 30-89 percent in the 21 wards of the Bharanikkavu gramapanchayath with an overall average reduction of 55.83 percent. Rapid technology dissemination achieved across the social system within two year period against a record of 7.2 percent awareness/ knowledge on red palm weevil among farmers. Expenditure on pest management reduced by 57 percent due to community decision making and area wide adoption and improvement in knowledge by 88.44 percent among the coconut farming communities.

These extension approaches and strategies were evolved over a period of time and through participatory social process among coconut farming communities. The paradigm shift in technology adoption unit enabled area wide up scaling rapidly and with triangulation of stakeholders. A comparison of the extension approaches over a period of time is furnished as follows.

The effectiveness of innovation system depends on the will of political institutions, general institutional environment of the social system, need based realistic technology demand by coconut communities/farmers/entrepreneurs and effective mechanisms for supply of knowledge and technologies through collaboration and interaction. The traditional wisdom for supply of knowledge and technologies evolved in farmer generations over centuries, in coconut based homestead farming, and enhanced their livelihood and nutritional security. This component of innovation warrants special attention in coconut, a perennial crop which is part and parcel of farm families, culture, food and livelihood. Any extension system cannot reach every farmer effectively. The extension approaches evolved in coconut could bridge the gaps of reaching out to more number of farmers in unit area (98 % small and marginal land holding in Kerala state), situation/crop/problem specific delivery mechanisms, ensuring social responsiveness and networking for technology access and evaluation, enabled experiential learning and real time feedback, refinement and achieving technology appropriateness. ■

Fodder grass cultivation in Coconut garden

P. Subramanian, Surekha, Ravi Bhat and C. Thamban
ICAR- CPCRI, Kasargod

Coconut is a small holder's crop being cultivated in humid tropics of India. It is mostly cultivated as a mono crop and coconut farming means livelihood for many of the farm families. Major soil types in which coconut is cultivated are red sandy loam, alluvial, lateritic and sandy soil.

Coconut garden is highly amenable for cultivating intercrops in the interspaces because of its wider spacing (7.5 m x 7.5 m). It is a well-established fact that a variety of crops can be successfully inter planted in the interspaces of coconut. Utilization of interspaces in coconut garden for cultivating fodder grass will provide excellent scope for coconut based mixed farming system. This in turn will help in better resource management and ensure higher returns.

Cultivation practices

Varieties

Even though many fodder grass varieties are in cultivation, hybrid bajra Napier (CO3, CO(CN) 4 and CO(BN)5 and guinea grass are more popular and successfully cultivated by the farmers because of their easy cultivation practices and higher fodder yield. These fodder grass varieties have high palatability among the milch animals. Guinea grass is also ideal for feeding goats.

Soil and climate

Fodder grass can be cultivated in a wide range of soils. However, well drained red sandy loam soil is best suited. It can also be successfully cultivated in hard laterite and coastal sandy soil by adopting appropriate moisture conservation practices.

It will thrive well in areas receiving evenly distributed rainfall. Irrigation is necessary during summer to get higher fodder yield.

Planting season

Fodder grass can be planted with the onset of monsoon (June-July). However, under irrigated condition planting can be done at any time of the year.

The varieties are Hybrid bajra Napier: (CO3, CO(CN) 4 and CO(BN) 5 and Guinea grass.

Guinea grass as intercrop in coconut garden.

Hybrid bajra napier as intercrop

Land preparation

The land should be thoroughly ploughed twice with the onset of monsoon to remove weeds and level the land. Trenches of 30 cm width, 30cm depth are to be made at recommended spacing in between two coconut rows leaving the basin area of 2m radius. In coastal sandy soil one layer of coconut husk is to placed in such a way that concave side is facing upwards in order to facilitate soil moisture retention. Vermicompost /cow dung @10 to 20 t/ ha should be applied in the trenches mixed with soil.

Planting

Select well matured stem cuttings of Napier grass having two nodes and plant the cuttings in slant position in the centre of the row in such a way that one node is inserted into the soil. In case of guinea grass rooted slips of 15 cm length are to be used. Root and shoot is to be trimmed before planting. It is advisable always to procure 10% extra planting material for gap filling requirement. Also take up planting in staggered manner at an interval of 15 days to ensure continuous supply of fodder.

Planting material requirement

Napier grass : 27,000 two noded cuttings for planting in one ha at a spacing of 60 cm X 60 cm

Guinea grass : 30,000 rooted slips for planting in one ha at a spacing of 50 cm X 50 cm

Manuring

Fertilizer	At planting/pre monsoon (kg/ha)		After each harvest (kg/ha)
	Hybrid Napier grass	Guinea grass	
Urea	106	65	106
Rock phosphate (Acid Soil)	162	162	-
Muriate of Potash	40	40	-
Single Super Phosphate (pH 7 and above soil)	313	313	

Establishment of Guinea grass

Hybrid bajra napier

Establishment of hybrid bajra napier grass stem cuttings in the trenches

For obtaining higher yield, recommended dose of organic manures and chemical fertilizers should be applied at the time of planting as basal dose. 50% urea and full dose of rock phosphate or single super phosphate are to be applied at the time of planting and the remaining 50% urea after 30 days of planting. Thereafter urea should be applied @ 106 kg after every harvest. In the second and subsequent years rock phosphate and muriate of potash should be applied during the pre monsoon period (May-June) while urea can be applied as top dressing after each harvest.

Gap filling

In order to ensure adequate plant population gap filling need to be taken 30 days after planting

Irrigation

Irrigation is to be provided during summer months once in three to four days by sprinkler irrigation method.

Harvesting

Harvesting the grass at the right stage is important to ensure good palatability. Both grasses will be ready for harvest in 80 days after planting. Subsequently grass can be harvested at 40-50 days interval. The grass may be cut at height of 5-10 cm above ground level for better regeneration. Fodder grass can be maintained for a period of 4 years. However maintenance up to 3 years is preferable. When the new planting is taken up, immediate planting of fodder grass in the same area is to be avoided. instead grow green manure plants in that area. It is preferable to grow green manure crops in that area for one season and then new planting shall be taken up.

Yield

	Fodder yield in different soil type (t/ha)*	
Fodder grass variety	Red loamy soil	Sandy soil
Hybrid bajra Napier CO3	120	96
Hybrid Cumbu Napier CO4	119	94
Hybrid Bajra Napier CO5	126	100
Guinea grass	110**	80

** Recorded at Kasargod*

***Expected yield*

A farmer can manage 6-8 cows with guinea grass or 10-12 cows with Napier grass grown in one hectare of coconut garden. Integration of dairy enterprise along with fodder cultivation ensures higher income. In addition cow dung, urine and other wastes can be effectively recycled as a nutrient source in fodder and coconut cultivation.

Effect of fodder intercropping on coconut yield

Intercropping of fodder grass will not affect the coconut yield. Fodder grass intercropping with integrated nutrient management practices has recorded 11 per cent increase in yield over monocroping of coconut. Experiments conducted at ICAR-CPCRI Kasargod has clealy demonstrated that intercropping will have a complementary effect on coconut productivity if proper nutrient management practices are adopted for the fodder crops. ■

Vermicomposting of stovers from baby corn, an intercrop in coconut garden

Alka Gupta[1], Murali Gopal[1] and H.P. Maheswarappa[2]
ICAR-Central Plantation Crops Research Institute, Kudlu P.O., Kasaragod, Kerala- 671124
[1]Principal Scientists , [2]Project Coordinator, AICRP on Palms

Baby corn cultivation as a component crop in coconut interspaces yield agro-residues in the form of baby corn stover after the harvest of cobs. The baby corn stover could be successfully converted to good quality vermicompost using the coconut leaf degrading epigeic earthworm, *Eudrilus sp.,* available at ICAR-CPCRI, Kasaragod. The baby corn stover vermicompost has 21% organic carbon, 2.3% nitrogen, 0.4 % phosphorus and 0.4% potassium. This study proves that the agro-wastes generated from coconut-based cropping system can be recycled within the farm for soil and plant health improvement.

Introduction

Vast amounts of residues are generated by growing agricultural and horticultural crops which provide a viable option to small and marginal farmers to produce good quality organic manure within their farm via agro-waste recycling technologies. Vermicomposting is one such option which farmers can exercise to produce quality manure to improve soil health and fertility of their farm for sustainable crop production. At ICAR-Central Plantation Crops Research Institute (CPCRI), technology was developed

Fig.1 Baby corn plants growing in the interspaces of coconut palms

to convert mature and senescent dry coconut leaves to vermicompost by addition of cowdung and an indigenous strain of *Eudrilus sp.* earthworms. Using this technology, approximately 4-5 tonnes of healthy organic manure can be produced annually from 1 ha

coconut garden, if coconut is grown as a monocrop. However, the large interspaces between coconut palms allow scope for growing a variety of crops which can be substantially exploited to improve the economic returns of the farmers throughout the year. Research in ICAR-CPCRI has developed a number of highly productive and remunerative farming/ cropping system models including intercropping systems, multi-storied cropping systems and high density multispecies cropping systems, wherein many crops and animal/fishery components were established as profitable units in coconut garden.

Baby corn as an intercrop in coconut garden

To expand the scope of intercrops that can be cultivated within coconut garden, a field experiment was conducted at ICAR-CPCRI farm wherein suitability of baby corn as an intercrop was evaluated. Baby corn (variety Syngenta G-5406) was successfully grown in the interspaces of the coconut palms (WCT var.) (Fig.1, Fig.2). Baby corn (also known as young corn) is a cereal grain from corn (maize) harvested immediately after silk emergence (usually after 50-60 days of planting) while the stalks are still small and immature. It is typically eaten whole-cob included, as a vegetable in the preparation of various dishes.

Residues from baby corn crop

The cultivation of baby corn generated baby corn stover (also referred to as maize stover) as a recyclable biomass or fodder for animals. Cob (Fig. 2) constitutes around 15% of the total dry mass of the baby corn crop, remaining approx. 85% of the total dry mass of the crop are the residues such as stalk, leaves and husk which are left in the field after harvesting of corn. These residues, called baby corn stover, consist of stalk (around 48% of total dry mass), leaves (28%) and husks (8%) of the plant. It is an agricultural residue similar to paddy straw that are either dried and burnt in the field or used as a source of roughage for dairy animals. As appreciable quantities of baby corn stover was generated in the field trials, it was decided to evaluate whether the coconut leaf degrading earthworm, Eudrilus sp., which has broad spectrum agro-waste recycling ability, could be extended to baby corn stover waste too. Our earlier studies had indicated that Eudrilus sp. can degrade not only coconut leaves, but also other agro-wastes which become available when inter- mixed crops are grown along with main crop i.e. coconut.

Fig.2 Satisfactory yield of baby corn cobs was obtained indicating its successful cultivation in a coconut garden

Vermicomposting of baby corn stover

An experiment was initiated to convert baby corn stover into vermicompost using the technology developed at ICAR-CPCRI for production of vermicompost from coconut leaves through the use of Eudrilus sp. (Fig.3) with minor variation. Baby corn stover was mixed with cow dung in 3:1 ratio. For each 60 kg of baby corn waste, 20 kg of cowdung slurry was mixed. Heaps of this mixture were readied in cement tanks and allowed to pre-decompose for two weeks before releasing 200 nos. of Eudrilus sp. earthworms per heap. The heaps were protected from direct sunlight and moisture was maintained by intermittent sprinkling of water on the heaps. There is no turning over required. After three months, the vermicompost produced was separated and earthworms were sorted manually.

On an average, 38 kg of vermicompost was produced per heap and the earthworm population doubled. The vermicompost was shade-dried and sieved to remove partially undegraded residues. Twenty five kg of such fine textured, high quality vermicompost was thus obtained which consisted of mainly earthworm casts (Fig.4) and microbially degraded residues (Table 1). Three samples of this vermicompost from each heap were analysed for nutrient, enzyme activities and microbial structure using appropriate standard analytical procedures.

Table 1 : Input and output details of baby corn stover vermicomposting				
Baby corn stover + cowdung input (kg)	Vermi-compost harvested (kg)	Fine, sieved, shade-dried ver-micompost recovered (kg)	Earth-worms added (nos.)	Earth-worms harvested (nos.)
60 + 20	38	25	~200	~400

Properties of stover vermicompost

The vermicompost produced from baby corn stover was dark-coloured, granular, alkaline in nature with pH of 7.45 and had high water holding capacity. The product had organic carbon content of 21%, total N, P and K content of 2.3%, 0.4% and 0.4 %, respectively (Table 2). It also had good amounts of micronutrients such as Fe, Cu, Zn and Mn apart from Ca and Mg. The baby corn stover vermicompost was found to have higher pH and nitrogen content than coconut leaf vermicompost (Table 2).

Table 2 : Comparison of physico-chemical properties of vermicom-post produced from baby corn stover and coconut leaves						
Vermi-com-post pro-duced from	Total N (%)	Total P (%)	Total K (%)	OC (%)	pH (%)	Mois-ture (%)
Baby corn stover *	2.33	0.4	0.4	21.13	7.45	80.66
Co-conut leaves	1.80	0.3	0.4	20.00	6.20	45-55
*All values are mean of three replications						
Average values obtained during trials carried out at different times during an extensive period						

The vermicompost produced was also microbiologically rich with plant-beneficial microbes such as phosphate solubilizing bacteria and fluorescent pseudomonads. Phosphate solubilizing bacteria make the unavailable form of phosphorus available to the plants for their uptake and fluorescent pseudomonads are well known for both their plant growth promoting properties and also biocontrol effects. Bacteria formed the largest group in the vermicompost followed by actinomycetes. Presence of higher numbers of actinomycetes is desirable as they are known to produce several metabolites including antibiotics and help in suppression of soil pathogens among other things.

Fig.3 Indigenous strain of Eudrilus sp. earthworm used for vermicomposting of baby corn stover

Fig.4 Granular vermicompost produced from baby corn stover showing earthworm casts

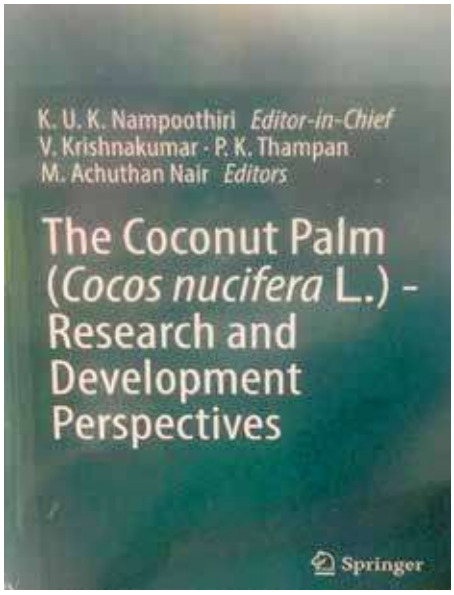
Analysis result of the baby corn stover vermicompost for some important enzyme activities shows that the vermicompost had high dehydrogenase, phosphatase and urease activities indicative of high microbial activity. Production of these extracellular enzymes, particularly phosphatase and urease, are significantly relevant in terms of phosphate- nitrogen mineralization in soil, therefore, impacting the soil fertility positively.

Summary

Present studies indicated that residues from baby corn, which can be grown as a viable intercrop in coconut garden, can be successfully recycled to good quality vermicompost using the coconut leaf degrading earthworm, *Eudrilus sp.* This further widens the spectrum of agro-waste degrading capability of this indigenous *Eudrilus sp.* Farmers who intend to cultivate baby corn within their coconut gardens can now have additional source of input for manure production to improve their farm soil and plant health. They can also sell the vermicompost to generate additional income for their family. ■

The Coconut Palm (*Cocos nucifera L*) - Research and Development Perspectives

The Coconut, *Cocos nucifera L* (Arecaceae) is a versatile and multipurpose palm and is a crop which probably enjoys a number of synonyms and pet names. The Coconut research in India has had a recorded history of more than 100 years; but systematic works were initiated and gained momentum with the establishment of research stations under the Indian Council of Agricultural Research (ICAR) in 1960s. There has been, however, a limited effort to consolidate the vital research results and valuable knowledge accrued during the last century which in turn, resulted in the poor level of transfer of technology.



A comprehensive book, 'The Coconut Palm (*Cocos nucifera L*) - Research and Development Perspectives' published by Springer Nature Singapore Pvt.Ltd., a global publisher dedicated to providing the best possible service to the whole research community, has captured all available information which were otherwise scattered and remained under-utilized. Dr KUK Nampoothiri, a well known scientist in the ICAR research institute is the Editor-in-Chief. Dr. V. Krishna Kumar, Shri.P.K. Thampan and Shri.M. Achuthan Nair are the editors who have wider knowledge and in-depth expertise in coconut sector. They have done their job well in presenting a beautiful publication to the readers.

The book in 17 chapters which have been well written by the authors who have vast experience in the respective fields, synthesized various aspects of this wonderful crop, origin to cultivation, breeding, physiology, value addition, nutrition and health, biotechnology, besides an exhaustive chapter on international scenario of coconut. The vast and in-depth knowledge of many former scientists in ICAR-CPCRI has also been made use of in different chapters. The book will serve as an important resource guide to scientists, farm managers, development agencies, extension workers, coconut farmers and more so to research students as a good compilation of all past works.

Enthrallment of voluminous references in each of the chapters, excepting in the nascent areas like value addition and health and nutrition, has added immense volume to the book. As a compilation of Research and Development Perspectives, as the name indicates, the publication lacks a well drawn growth trajectory of coconut development in the country. Though good documentations are available as in the case of Research, proper compilation and updation ought to have been found a place in such a comprehensive book. Considering this, regular revision of this edition with updated R&D would fill the gap.

This is an important achievement and comes at the right time of celebrating the century of coconut research. The book as a whole leave a useful message in the minds of the reader that Research and Development of coconut invariably has a responsibility of sustaining the 'bio-happiness' of the coconut farmers.

Dr. Remany Gopalakrishnan. Former Director i/c CDB and CEO of Onattukara Coconut Producer Company Ltd, Alappuzha.

Science and technology for agricultural development

Amit Kumar and Nidhi Sharma
Department of Extension Education CCS Haryana Agricultural University,
Hisar-125004 Haryana-125004 India

Science may not be the first thing that comes to mind when you think about development, but it very often forms the foundation of solutions and trace-up some of the world' s most critical aspects such as ensuring that people can grow enough food for consumption. There have been some recent developments though on a relatively small scale. Access to science-based information can make the difference between whether the harvest will flourish or fail. Agricultural information is readily accessible to farmers in the developing world. Knowledge sharing and knowledge transfer are the keys to building the livelihoods of some of the world's poorest smallholder farmers who grow food to eat or to sell on a small scale. Surprisingly, mobile technology is fast becoming as one of the best ways to reach farmers with information. Around 40% of people in the developing world now actively subscribe to mobile services with 130 million new subscribers every year and mobile 2G coverage is available for around 95% of users. Agriculture has a rich

Agricultural information is readily accessible to farmers in the developing world. Knowledge sharing and knowledge transfer are the keys to building the livelihoods of some of the world's poorest smallholder farmers who grow food to eat or to sell on a small scale.

tradition of embracing technology to improve crop production, revolutionize how farmers can run their business and transform the rural communities. Technology is changing the agricultural industry by replacing human labour with machines that are operated or controlled by people or other machines. In the agricultural industry productivity is a key factor. if the production is high, the farmer will make more profits. Technology has helped farmers replace the old ways of farming with machines that can do the job in less time right from the day of planting to the day of harvesting. On the other hand many smallholder farmers around the world are still doing their agricultural work in the same way as their ancestors did thousands of years ago. Traditional farming approaches may continue to work for some but new practices can help many to substantially improve yield, soil quality and natural capital as well as food and nutrition security. For instance, advances in satellite mapping and information and communications technologies (ICTs) are transforming more traditional agricultural extension work today. Today it is possible to grow crops in a desert by using agricultural biotechnology. With this technology plants have been engineered to survive in drought conditions. Through genetic engineering scientists have managed to introduce traits into existing genes with a goal of making crops resistant to droughts and pests.

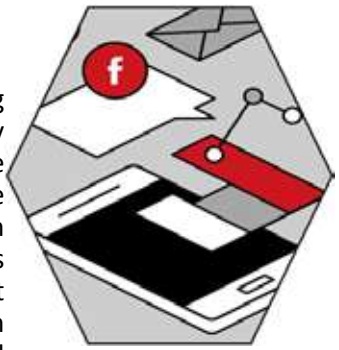
Extension advisory service

In this digital era dissemination of information is a must for maintaining sustainability in agriculture or other field. Extension is one of the essential services in the present scenario to bridge the gap between scientist and farmers to ensure that what is developed in the lab reaches the field. Technology development and information dissemination, strengthening farmers' capacity, facilitation and policy support forms the pillars in relation to application of science.

Use of machines and high intensive tools on farms

Now it is possible to cultivate on more than two acres of land with less labour and can cut down the cost by deploying used machinery and other harvesting technology in place of new equipments. With regard to intensive tools, farmers can use tools like drone for identifying the weeds, insect pest etc. Modern agricultural technology allows a small number of people to grow vast quantities of food and fibre in a short period of time.

Modern transportation



This helps in making the timely availability of products available in the markets. The modern transportation technology help farmers to easily transport fertilizers or other farm products to farms and also speed up the supply of agricultural products from farm to the markets where the consumers get them on daily basis.

Cooling facilities

Cooling facilities help farmers to deliver green vegetable and other perishable crops to keep them fresh when it is transported to the market. These cooling facilities are installed in food transportation trucks so that crops like tomatoes will stay fresh till the delivery. Consumers' get these products fresh and the farmer can easily sell their products as the products will be having high demand.

Genetically produced plants

Genetically produced potatoes, can resist diseases and pests, which rewards the farmer with good yields and saves his time. These crops grow very fast and produce healthy yields. Since resistant to most diseases and pests the farmer will have to spend less on pesticides which in return increases in their return. Biotechnological advances allow farmers to grow more crops on less land using farming practices that are environmentally sustainable. Through biotechnology seeds yield more per acre, plants naturally resist insect pests and diseases, and farming techniques improve soil conservation. Farmers can help plants and animals fight diseases and adapt to environmental stress and climate change. We can enhance the nutritional content of foods and improve human health through plant- and animal-produced therapies. The benefits of biotechnology are especially meaningful at a time when our global population is growing and our demand for food is increasing, especially in developing countries. Today, this technology has reached a stage where transgenic plants have been developed as a result from genetic engineering experiments in which genetic material is moved from one organism to another, so that the latter will exhibit desired characteristics.

Development of animal pasture

This has solved the problem of hunting for grass to feed animals which can be manufactured and consumed by animals. The price of these feeds are affordable for farmers too. Most of these manufactured animal feeds have extra nutrition which improves the health of the animals which in turn improves the yield of the animals. Most of these genetically produced animals will produce more milk or fur compared to normal animals. This benefits the farmer because their production will be increased.

Irrigation of plants

In dry areas like deserts, farmers have embraced technology to irrigate their crops. A good example is in Egypt, where farmers use water pumps to collect water from river Nile to their crops. Most of these farmers grow rice which needs a lot of water, so they manage to grow rice using the irrigation methods developed by advanced technology. Advanced water sprinklers are being used to irrigate big farms and this helps the crops get enough water which is essential in their growth. Some farmers mix nutrients in this water which further improves the growth of the crops.

Internet

Use of Internet makes every information easily accessible only in a few clicks away. In today's world of competition information is the key to success. Availability of right information at the right time can make all the difference.

Science and science- based technology has transformed modern life which has led to major improvements in agriculture as well as in the living standard of the people. Application of science has made possible the things that were hard for farmers to carry out in the field. The modern technology has developed new avenues in scientific farming and the development in information technology has played a great role in creating awareness among the farmers to adopt the science-based technology in every day agriculture. ■

Bio control of coconut black headed caterpillar in Maharashtra

Wankhede, S. M. , Shinde V.V., Jilu, V. Sajan and Maheswarappa, H.P.
AICRP on Palms, RCR, Bhatye, Ratnagiri, Maharashtra

Coconut black headed caterpillar or leaf eating caterpillar (*Opisina arenosella*) is a serious pest of coconut causing significant yield loss in all the coconut growing tracts of India.

It infests coconut of all age groups and is a prolific feeder of coconut leaves. On the adult palms, the infestation starts on the outer whorls of leaves and eat away the chlorophyll leaving only upper epidermis thereby, reducing photosynthetic efficiency. In extreme cases the caterpillar may feed on the surface of green nuts. In severe cases, whole plantation presents a burnt up appearance due to the drying of leaves. In case of severe outbreaks the attacked leaves droop, bunches buckle and the immature nuts shed heavily.

Biocontrol

Black headed caterpillar spread very fast and cause heavy damage to coconut gardens in a large area. Chemical management is not a feasible method for the control of this pest. The larval parasitoids of black headed caterpillar viz., Bracon hebetor and Goniozus nephantidis are found effective in managing the pest. Inundative release of these parasitoids help in containing the outbreak from spreading to neighboring coconut growing areas. Usually the parasitoids G. nephantidis are to be released at the rate of 10 parasitoids/palm and B. hebetor at the rate of 20 parasitoids/palm in at least ten per cent of the infested palms in each area at fortnightly intervals in case of low (few damaged leaflets here and there) to medium (2–3 damaged fronds with clear drying) intensity of damage. For high intensity damage, (all the lower whorls of leaves or entire crown damaged) more number of parasitoids should be released.

Damaged palm before release of parasitoids

Recovered palm after release of parasitoids

Biological control laboratory

The self-perpetuating parasitoids prevent the further spread of the pest and reduces the need for use of hazardous insecticides in the coconut ecosystem. A community based approach is needed for the effective management of the pest. The farmers should be sensitized on pest identification, nature of damage and management of black headed caterpillar through bio-control and parasitoid release via field visits, village meetings, group discussions and mass media coverage.

Success stories from Ratnagiri

Scientists from AICRP Centre, Bhatye, Ratnagiri have made a concerted effort in managing the pest menace in Palghar dist. of Maharashtra.

In Nareshwadi, Palghar (Dist.), around 500 coconut palms aged 5-30 year were severely affected by black headed caterpillar. The pest damage was to the tune of 90 per cent and it reduced the productivity of palms to 30-40 nuts/palm. The scientists working in ICAR- AICRP on Palms centre RCRS Bhatye visited the plantation and immediate interventions were taken up. They released around 1200 Bracon and 500 Goniozus parasitoids in the farmer's field and timely intervention and effective monitoring of the pest population resulted in reduction of the pest population within five months.

During 2017-18, black headed caterpillar outbreak was reported in 350 palms in an area of 2 hectare in Palghar Dist. The damage was recorded to the tune of 100 per cent and 10,000 parasitoids were released in the field by scientists from RCRS, Bhatye. The timely release of parasitoids helped in reducing further damage and the palms were recovered after the release of parasitoids.

Community based release of parasitoids is a very effective, feasible and eco-friendly method of black headed caterpillar management. The ICAR-AICRP centre RCRS Bhatye is successful in identification of the pest problem and distribution of larval parasitoids in large numbers to the affected areas to contain the spread of the pest. ■

Entrepreneurship Development Programme on Value Chain in Coconut

An Entrepreneurship Development Programme for the selected young farmers and entrepreneurs from Lakshadweep islands on Value chain in coconut was conducted at ICAR-Central Plantation Crops Research Institute, Kasaragod on 29th April 2019. The programme sponsored by National Horticulture Board was envisaged to empower the selected young farmers and entrepreneurs from different Lakshadweep Islands to take up enterprises on production and marketing of coconut value added products and other coconut based enterprises for income and employment. Currently coconut sector in Lakshadweep islands mostly revolve around production and marketing of copra only. In the Entrepreneurship Development Programmes the thrust will be for empowering the young farmers from Lakshadweep islands for the formation of Farmer Producer Companies to take up production and marketing various value added coconut products targeting domestic and export markets. Besides, these FPOs can make efforts to tap the potential for marketing coconut value added products as 'Lakshadweep organic' brand. As part of the programme it is proposed to train a total of 100 selected farmers and entrepreneurs in five batches. Apart from the sessions at ICAR-CPCRI, Kasaragod, the trainees will be attached to the successful coconut based value addition units managed by entrepreneurs at different localities in Kerala.

The inaugural function of the Entrepreneurship Development Programme for the first batch of participants held ICAR-Central Plantation Crops Research Institute, Kasaragod was presided over by Dr. Anitha Karun, Actg. Director, ICAR-CPCRI. Dr. K. N. Satheeshan, Associate Director of Research, Regional Agricultural Research Station, Pilicode inaugurated the programme. Mr. S.S. Purty, Horticulture Officer, National Horticulture Board offered felicitations. Dr. C Thamban, Principal Scientist and Course Director welcomed the gathering and presented the outline of the Entrepreneurship Development Programme.

Dr. Shameena Begum, Scientist (Food Processing) proposed vote of thanks. The participants of the first batch of EDP were divided into four groups and were attached to SUBICSHA Coconut Producer Company, Naduvannur, Kozhikode district, Thejaswini Coconut Producer Company, Cherupuzha, Kannur district, Magico coconut chips unit, Madikkai, Kasaragod district and Shree Kalpa Coconut Industries Kumbala, Kasaragod district for hands on training as part of the attachment to the successful coconut based value addition units managed by entrepreneurs.

Dr. Ariz Ahammed IAS, Managing Director, National Horticulture Board interacted with the participants of the programme on 16th May, 2019. Dr. K. Muralidharan, Director-in-charge, CPCRI, distributed certificates to the participants in the valedictory function held on 17th May 2019. Dr. P. Muralidharan, Principal Scientist & Head, Krishi Vigyan Kendra, Alappuzha was the guest of honour in the valedictory function. Dr. K. Samsudeen, Principal Scientist CPCRI, offered felicitations. Dr. Thamban, C., Principal Scientist and Course Director proposed vote of thanks.

Obituary

Shri. Joseph Alappatt (81) former Vice Chairman of the Board expired. He was the Vice Chairman of the Board during 1986-89. He has also served as member of various committees of Coconut Development Board.

Chairperson CDB visited the DSP Farms of the Board






Smt.V.Usha Rani IAS, Chairperson, CDB visited the DSP Farm of the Board at Dhali, Tamilnadu on 22nd April 2019 and reviewed the activities of the Farm. Member farmers from 14 CPCs in Tamil Nadu met the chairperson in the farm and interacted with her. Shri.Mohanraj, CDB member representing Tamil Nadu and Smt.T.Bala Sudhahari, Director i/c, CDB, RO Chennai participated in the meeting, along with other CDB officials from DSP Farm, Dhali. Chairperson was happy to notice that nine out of the 17 CPCs in Tamil Nadu are already into Neera tapping and assured to extend all possible help from CDB to the farmers. The Chairperson visited TNAU and had discussions with Dr.N.Kumar, Vice Chancellor, TNAU on promoting R & D in Value addition in coconut. Chairperson also paid visit to few coconut processing units in the area.

Smt.V.Usha Rani IAS, Chairperson, CDB visited the DSP Farm of the Board at Mandya, Karnataka on 8th May 2019 and reviewed the activities of the Farm. She suggested various measures to improve the functioning of the Farm.

Workshop-cum-Training on Plant Health Management in Coconut

A Workshop-cum-Training on Plant Health Management in Coconut was organised at ICAR –Central Plantation Crops Research Institute, Kasaragod on 14th May 2019.

The programme was conducted with the objective of creating awareness about the status of pest and disease incidence in coconut and crop loss incurred thereof and to enhance knowledge about the integrated pest and disease management strategies recommended to manage the pests and diseases of coconut to avoid crop loss and for creating awareness about the prophylactic plant protection measures in coconut to be adopted before the onset of south west monsoon.

Selected farmers from all gramapanchayats of Kasaragod district and extension personnel of Department of Agriculture and Farmers' Welfare participated in the workshop-cum-training.

Mrs.Tizamma Thomas, Principal Agricultural Officer, Kasaragod inaugurated the programme and Dr. K.B. Hebbar, Director- in -charge CPCRI, presided over the inaugural function.

In the inaugural function, Mr. A.A. Jaleel, President, Mogral-Puthur grama panchayat released the publication on 'Incidence and intensity of pests and diseases of coconut in North Kerala, and offered felicitations.

Mrs. Stella Jacob, Project Director, Agricultural Technology Management Agency (ATMA), Kasaragod also addressed the gathering in the inaugural function.

Dr. Leena, S., Chief Technical Officer, Krishi Vigyan Kendra and Mrs. Mrs.Tizamma Thomas, Principal Agricultural Officer, Kasaragod who are superannuating from the service by the end of May 2019 were felicitated in the inaugural function.

Dr. C.Thamban, Principal Scientist, CPCRI spoke on 'Status of pest and disease incidence in coconut in northern Kerala and crop loss incurred' and Dr. P.S.Prathibha, Scientist, CPCRI spoke on 'Integrated pest and disease management in coconut- prophylactic measures at the onset of monsoon'.

After the presentations, group discussion on 'Strategies for scaling up the adoption of recommended technologies by coconut growers through appropriate interventions of State Dept. of Agriculture/ATMA/Local Self Governments' was held. Mrs. Sajanimol, Mrs. Sushama, Mr. Krishnadas, Mr. Umesh, Deputy Directors of Department of Agriculture and farmers participated in the group discussion.

Dr. C.Thamban, Principal Scientist, welcomed the gathering and Dr. K.P.Chandran, Principal Scientist, proposed vote of thanks.

Retirement

Shri. P.K. Umeswaran retired from the services of Coconut Development Board on 30th April 2019 on superannuation. He joined the Board in 1986 and has served the Board for more than 33 years.

Cultivation practices for coconut-June

Sowing of seednuts in nursery

Well-drained, coarse-textured soil near dependable irrigation water source should be selected for raising the nursery. The seed nuts can be sown in flat beds if there is no drainage problem.

The seeds are to be sown in raised beds, if water stagnation is a problem. Nursery can be raised either in the open with artificial shade or in gardens where the palms are tall and the ground is not completely shaded. The seed nuts should be sown in long and narrow beds at a spacing of 40 cm x 30 cm either vertically or horizontally in 20-25 cm deep trenches. Advantage of vertical planting cause less damage during transit of seedling. However, in delayed planting, when the nut water goes down considerably, adopt horizontal sowing. It is better to go for horizontal sowing of seed nuts for better germination.

Seedling selection for planting

Only good quality seedlings are to be selected from the nursery for field planting. In tall varieties, vigorous seedlings which are one year old, more than 100 cm in height with 5-6 leaves and girth of 10 cm at the collar should be selected for planting. In dwarf varieties, the girth and height of good quality seedlings should be more than 8 cm and 80 cm, respectively. Early splitting of leaves is another character preferred for selecting good seedlings. Generally, one year old seedlings are preferable for planting. However, for planting in water-logged areas, 1½ to 2 years old seedlings are to be preferred.

Seedlings raised in poly bags perform better. The advantage of polybag seedlings is that, there is no transplanting shock since the entire ball of earth with the root system can be placed in the pits and the seedlings establish early and more vigorously. But the disadvantages include difficulty for transportation and higher cost of seedling production.

Planting

In well drained soils, seedlings can be transplanted with the onset of south-west monsoon during June. A spacing of 7.5 m x 7.5 m to 8.0 m x 8.0 m in the square system is generally recommended for coconut. This will accommodate 177 and 156 palms per ha, respectively. If the triangular system is adopted, an additional 25 palms can be planted. Hedge system can also be adopted giving a spacing of 6.5 m along the rows and 9.5 m between rows. For facilitating multiple cropping in coconut gardens, it is advisable to go for wider spacing of 10 m x 10 m so as to provide ample opportunity to accommodate a number of perennial and annual crops in the interspaces.

The depth of planting pits will depend upon the type of soil. In laterite soil with rocky substratum, deeper and wider pits, 1.5 m length x 1.5 m breadth x 1.2 m depth may be dug and filled up with loose soil, powdered cow dung and ash up to a depth of 60 cm before planting. In case of laterite soil, application of 2 kg of common salt will help in loosening the soil. In loamy soils with low water table, planting in pits of 1 m x 1 m x 1 m filled with top soil to height of 50 cm is generally recommended. The coconut seedlings are planted in the centre of the pit by making small hole within the pits and the soil around the seedlings

must be firmly pressed, but soil should not be allowed to bury the collar region of the seedling or enter into the leaf axils. However, when the water table is high, planting at the surface or even on mounds may be necessary. While planting on the surface or mounds also, digging pits and soil filling has to be done. While filling the pits with soil, it is advisable to use top soil. Two layers of coconut husk (with concave surface facing up) can be arranged at the bottom of the pit before filling up. This will help in conserving the moisture. The seedlings, after field planting, are to be protected from heavy wind by staking and from sunlight by proper shading using plaited coconut leaves or palmyrah leaves or any other suitable shading materials. If there is no rain after planting seedlings are to be adequately irrigated.

Further, if continuous heavy rain occurs after planting care should be taken to avoid water stagnation in the pit by providing drainage. Bund should be made around the planting pit using bottom soil to avoid run-off water entering the pit.

Application of fertilizers

Under rainfed conditions one third of the recommended dose of chemical fertilizers can be applied to the coconut palms with the onset of south west monsoon. Application of 500 g N, 320 g P2O5 and 1200 g K2O 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). 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. Skipping of phosphatic fertilizer application is recommended if the available soil phosphorus is above 20 ppm.

If the coconut palms are maintained under irrigation, one fourth of the recommended dose of chemical fertilizers should be applied to the coconut palms during June.

It is always advisable to analyse the soil and leaf once in three years and based on the results, fertilizer application should be done.

Application of soil amendments

If application of soil amendments has not been done during May because of non-receipt of summer showers 1 kg of dolomite or 1 kg of lime may be applied per palm during June at least 15 days prior to the application of chemical fertilizers.

Application of biofertilizers

Biofertilizer application should coincide with the onset of monsoon, especially when the palms are maintained under rainfed condition. Formulations containing *Azospirillum spp*. and Phosphate solubilising bacteria prepared in carriers such as talc or vermicompost each are to be applied @100 g per palm.

'Kera Probio' (a talc formulation of *Bacillus megaterium,* a phosphate solubilising bacteria) can be applied to coconut seedlings @ 25 g per seedling mixed with vermicompost or farm yard manure while planting. Similarly an Arbuscular Mycorrhizal Fungal (AMF) bioinoculant, '*KerAM*' can be applied @50 g per seedling.

Basin management with legume cover crops

Green manure legumes like *Pueraria phaseoloides*, *Calopogonium mucunoides*, cowpea (*Vigna unguiculata*), sunhemp (*Crotolaria juncea*), horse gram (*Macrotyloma uniflorum*), daincha (*Sesbania aculata)* and *Sesbania spinosa* can be raised in the coconut basin and incorporated into the soil as green manure at 50% flowering stage. Seeds of these crops @ 100 g per basin can be sown in the palm basin at a radius of 1.8 m during June.

Dismantling of drip irrigation system

After the monsoon sets in during June, laterals of the drip irrigation system should be dismantled and rolled back and kept tied on a pole or on a coconut

tree trunk at the starting point of the irrigation system in the coconut garden.

Planting of intercrops

Planting of suitable inter/mixed crops can be taken up in coconut garden during June. Intercrops like banana, pineapple, ginger, turmeric, tapioca, sweet potato and perennials like, black pepper, nutmeg, clove, cinnamon, vanilla, cocoa etc. can be planted.

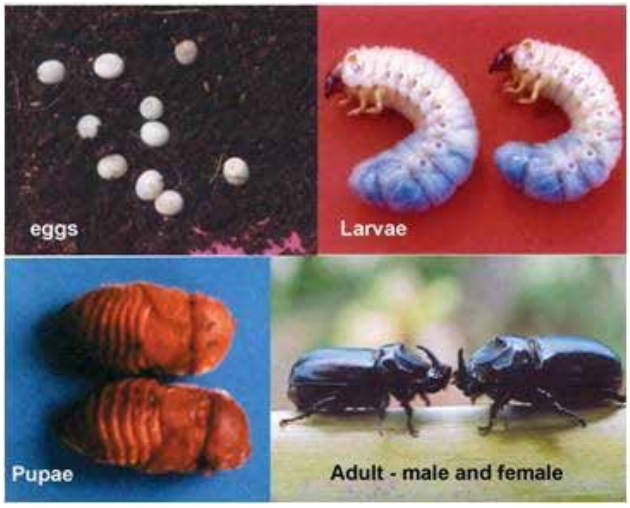
Plant protection

Peninsular India, the dominant coconut growing region in the country would receive South-West monsoon showers during the period of June. Palms therefore would re-adjust from dryness to wetness with the active formation of feeding roots in this period. Palm health need to be rejuvenated with soil-test based nutrition along with prophylactic management module and routine scouting to tackle pests and diseases. Heavy monsoon showers are likely to wipe away the sucking pest complex including coconut eriophyid mite and invasive whiteflies and also suppression of black headed caterpillar to a greater extent. Two major coconut pests, viz., coconut rhinoceros beetle and red palm weevil are a major concern in this period and the emergence of adult beetles of white grub would be quite prominent with receipt of monsoon showers which would be the right time for mechanical collection of beetles. Farmers should adopt all prophylactic measures such as leaf axil filling with neem cake admixed with sand and also application of 1% Bordeaux mixture in bud rot endemic zones. Timely prophylactic treatment in bud rot endemic zone is very critical to save the palm, as spotting the disease symptoms would be difficult in the initial stage of infection for which Unmanned Aerial Vehicle are smart tools in pest surveillance.

Pests

Rhinoceros beetle (*Oryctes rhinoceros*)

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



Life stages of the pest

▶ *Management*

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

Nut damage

Elephant-tusk like symptom

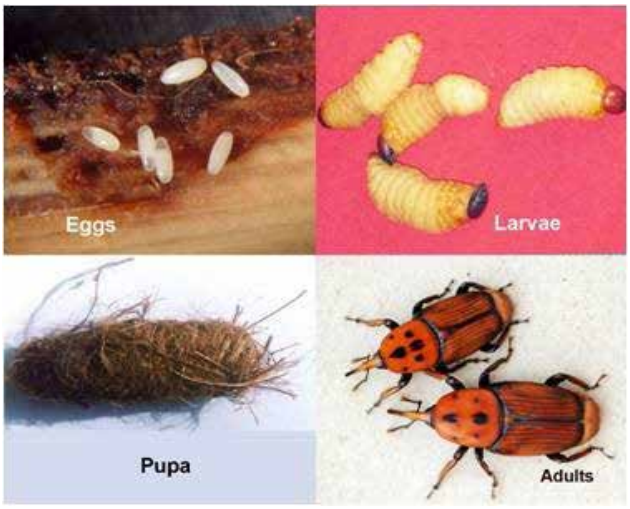
from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.

- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole / fipronil on top most three leaf axils evade pest incursion.
- Dairy farmers could treat the manure pits with green muscardine fungus, *Metarhiziumanisopliae* @ 5 x 1011spores /m3 to induce epizootics on the developing grubs of rhinoceros beetle. Area-wide farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.
- Incorporation of the weed plant, *Clerodendroninfortunatumin* 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.

Metarhizium packets

Red palm weevil (*Rhynchophorusferrugineus*)

This is the fatal enemy of coconut and any injury to palms will predispose pest invasion. Dwarf genotypes and palms aged between 5-15 years are relatively more susceptible. All life stages of the pest were noticed inside the infested palms. Leaf splitting



Life stages of the pest

at base, yellowing of middle leaves, presence of boreholes and oozing of brown fluid are some of the visible damage symptoms. Correct geometry is very crucial for accommodating intercrops as well as pest avoidance due to multiple odour cues.

▶ *Management*

Red palm weevil infestation on palms

- Field sanitation is very critical and all residual population in crown toppled palms should be destroyed
- Avoiding palm injury is very critical to disorient the gravid weevils away from the field and therefore leave out at least one metre from palm trunk when petioles are cut.
- Crop geometry and correct spacing is very crucial to reduce pest attack.
- Timely and targeted spot application of imidacloprid 0.002% (1 ml per litre of water) or indoxocarb 0.04% (2.5 ml per litre of water) on infested palms would kill the feeding grubs and induces recovery of palms by putting forth new spear leaf.
- Crop-habitat diversification (Ecological Bio-engineering) through coconut based cropping system strategy inciting defenders and pollinators would diffuse the palm-linked volatile cues and encouraged pest suppression. Diversified cropping system reduces pest incidence than mono-cropping.

White grub (*Leucopholisconeophora)*

Summer ploughing

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

White grubs

Adult beetles

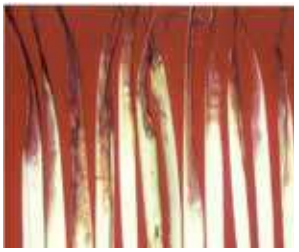
▶ *Management*

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

Diseases

1) Leaf rot disease (*Colletotrichum gloeosporioides, Exserohilumrostratum*)

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 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 .In disease endemic areas prophylactic fungicide treatment can also be given.

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

In certain humid locations bud rot occurred regularly killing hundreds of trees.In India, bud rot incidenceis recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or spindle turns brown and bends down. The affected spear leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Temperature range of 20- 24ºC and relative humidity of 98% - 100% were found optimum for the development of the bud rot disease. Contiguous occurrence of such "favourable days" during rainy seasons determines the development of the disease and the intensity of infection. As Phytophthora diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.

▶ *Management*

- Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence.
- Field sanitation and provide proper drainage during rainy season.
- Placement of two Trichoderma (Trichoderma harzianum CPTD28 isolate) enriched coir pith cakes in the inner most leaf axils just before the onset

of monsoon and again after every two months as prophylactic measure.

- In disease affected palms, remove the entire rotten portion of the spindle by cutting with a sharp knife and apply 10% Bordeaux paste to the wound and cover with polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.

Area wide and farmer-participatory adoption of prophylactic management practices could reduce the inoculum pressure of pest /disease even in favourable weather condition. Greater emphasis should be given for correct diagnosis and timely adoption of pest management practices. The concept of ecological engineering should be given due importance to obtain regular income from the farm and induce pest regression as well. Soil test based nutrition is also very crucial for improving palm health and endure biotic stresses. ■

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

Market Review – April 2019

Domestic price

Coconut Oil

During April 2019 the price of coconut oil opened at Rs.16300 per quintal at Kochi and Alappuzha market and Rs.16700 per quintal at Kozhikode market. During the month, price of coconut oil at all three markets expressed an overall downward trend.

The price of coconut oil closed at Rs.15900 per quintal at Kochi and Alappuzha market and Rs.16200 per quintal at Kozhikode market with a net loss of Rs.400 per quintal at Kochi and Alappuzha market and Rs.500 per quintal at Kozhikode market.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs.12667 per quintal, expressed downward trend during the month and closed at Rs.12333 per quintal with a net loss of Rs.334 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.04.2019	16300	16300	16700	12667
07.04.2019	16300	16300	16700	12333
14.04.2019	16000	16000	16500	12000
21.04.2019	16000	16100	16500	12467
30.04.2019	15900	15900	16200	12333

Milling copra

During the month, the price of milling copra opened at Rs.10200 per quintal at Kochi, Rs.10100 per quintal at Alappuzha and Rs.10450 per quintal at Kozhikode market. The price of milling copra at all three markets expressed an overall downward trend during the month.

The prices closed at Rs.9900 at Kochi market, Rs.9800 at Alappuzha and Rs.10050 at Kozhikode markets with a net loss of Rs.300 per quintal at Kochi and Alappuzha market and Rs.400 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices opened at Rs. 9000 per quintal and closed at Rs.8900 per quintal with a net loss of Rs.100 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.04.2019	10200	10100	10450	9000
07.04.2019	10100	10100	10400	8900
14.04.2019	10000	9800	10250	8800
21.04.2019	10100	10000	10300	9000
30.04.2019	9900	9800	10050	8900

Edible copra

The price of Rajapur copra at Kozhikode market opened at Rs. 16300 per quintal expressed a downward trend during the first week of the month. Price then increased during the second week and thereafter expressed a downward trend closing at Rs.16500 per quintal with a net gain of Rs.200 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.04.2019	16300
07.04.2019	16000
14.04.2019	16900
21.04.2019	16700
30.04.2019	16500

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 by the fag end of the month price increased and closed at Rs.16500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
01.04.2019	16500
07.04.2019	16500
14.04.2019	16200
21.04.2019	16100
30.04.2019	16500

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.7700 per quintal expressed an overall downward trend except during the first week of the month. The prices closed at Rs.7000 per quintal with a net gain of Rs.700 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.04.2019	7700
07.04.2019	8000
14.04.2019	7650
21.04.2019	7350
30.04.2019	7000

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.15000 per thousand nuts and closed at Rs.14000 per thousand nuts during the month. At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.12000 per thousand nuts and closed at Rs.11000 per thousand nuts. At Bangalore APMC, the price of partially dehusked coconut opened at Rs. 20500 and closed at Rs.18500 per thousand nuts.

Weekly price of coconut at major markets (Rs /1000 coconuts)			
	Nedumangad	Pollachi	Banglore
01.04.2019	15000	12000	20500
07.04.2019	15000	12000	20500
14.04.2019	14000	12000	20500
21.04.2019	14000	12000	20500
30.04.2019	14000	11000	18500

International price

Coconut oil

The international price of coconut oil and domestic price of coconut oil in Indonesia, Srilanka and India expressed a slight fluctuating trend during the month. The domestic price of coconut oil in Philippines expressed a slight downward 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*
06/4/2019	669	650	655	1,860	1,776
13/04/2019	681	645	647	1,861	1,728
20/04/2019	674	634	649	1,861	1,796
27/04/2019	658	633	637	1,855	1,776
					* Kangayam

Copra

The domestic price of copra at Philippines, Indonesia and India expressed a slight fluctuating trend during the month while a slight downward trend was noticed 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*
06/4/2019	424	395	944	1282
13/04/2019	431	390	944	1267
20/04/2019	430	392	944	1296
27/04/2019	427	387	941	1260
				* 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*
06/4/2019	113	140	156	389
13/04/2019	115	140	156	382
20/04/2019	115	141	156	382
27/04/2019	115	141	157	374
				*Pollachi market