KALPA

CPCRI Newsletter

Volume 38 No. 1 January–March, 2019

ICAR-CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
Kasaragod, Kerala - 671 124

From the Director's Desk

Inclusive Growth and Sustainability

"No conception of India's development can be complete without a salute to our spirit of inclusiveness - of access and opportunity for all" accentuated Shri Ram Nath Kovind, Hon'ble President of India while addressing the Nation on the eve of India's 70th Republic Day. True to this spirit, the ICAR-CPCRI has implemented many programmes, with a financial outlay of ₹102.4 lakhs, directly benefitting the socially and economically weaker sections of our country. Such initiatives include establishment of coconut nurseries in the *Gaja* cyclone affected areas in Tamil Nadu and measures to improve the livelihoods of people affected with floods in Kerala.

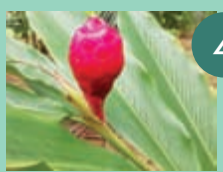
Inseparable with inclusiveness is the challenge of doubling the income of all farmers by 2022, a target set by Shri Narendra Modi Ji, our Hon'ble Prime Minister. With cyclic price crash being experienced with various plantation crop commodities the sector experiences greater challenge in achieving this objective. The smallholder perspective in research requires further emphasis and evolution and adoption of technologies need to be rapid and specific. Recently developed technologies like 'Kalpa- Poshak and Vardhini', nutrient mixtures aimed to improve growth and yield of coconut; composting of coconut husk, and emergency preparedness of invasive pests like whiteflies are reported here.

The Institute also collaborates with other stakeholders to promote farmer participatory decentralized coconut nurseries for production and supply of quality planting material, innovative capacity building programmes to address the issue of lack of skilled labourers etc. that are definite steps towards convergence for sustainable development of Indian plantation in general and coconut sector in particular.

Dr. Anitha Karun takes over charge

Dr. (Mrs.) Anitha Karun, Principal Scientist (Horticulture) assumed charge as Acting Director, ICAR-Central Plantation Crops Research Institute (CPCRI) from 11th January, 2019 at Kasaragod. She succeeds Dr. P. Chowdappa, who laid down office on voluntary basis on 10th January, 2019. Dr. Anitha Karun has vast experience in the field of tissue culture, biotechnology, horticulture and plantation crops. She has been serving the CPCRI for more than 27 years and developed important technologies such as embryo rescue protocol in coconut, coconut and arecanut tissue culture, cryopreservation of coconut pollen and molecular biotechnological aspects.

CONTENTS



Spectrum

Cryopreservation of coconut germplasm in National Cryo Genebank

The objective of germplasm conservation is to preserve the genetic diversity for its use in future breeding programmes. An effort for complementary conservation of core germplasm of coconut at National Cryo Genebank, ICAR-NBPGR, New Delhi is underway. Till date, zygotic embryos from 12 accessions, pollen from 14 accessions and DNA from 13 accessions of coconut germplasm have been cryo-stored for conservation in National Cryo Genebank as a base collection (Fig. 1).

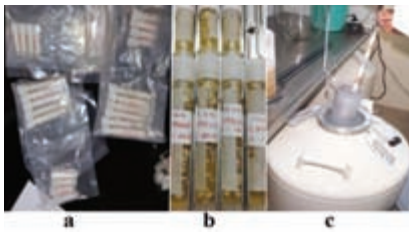


Fig. 1. Conservation of core germplasm of coconut by cryopreservation in the form of (a) pollen, (b) zygotic embryo and (c) DNA

Anitha Karun, Krishna Prakash, Niral, V., Muralikrishna K.S. and Rajesh, M.K.

Efficiency of Kalpa Poshak on the growth of hybrid coconut palms

Field evaluation of the efficiency of 'Kalpa Poshak', a nutrient mixture developed for the growth of seedlings and juvenile palms, on the performance of twenty month old Kalpa Sankara hybrids indicated that soil application of Kalpa Poshak @ 100g per palm in four split doses resulted in the enhanced leaf Ca (0.447%) and Mg (0.171%) constituents. This treatment also recorded the greatest increase in height, the number of split leaves and collar girth.

Jeena Mathew, Abdul Haris, A., Krishnakumar, V., and Ravi Bhat

Microbial succession in soils of permanent manurial trial

Microbial analysis of rhizosphere soils (up to 30 cm depth) of coconut plantation under permanent manurial trial was carried out using the culture-dependent method, employing both general and differential culture media. Both general and function-specific microbial groups were studied. An analysis of the data obtained showed an ecological succession of microbiota in response to environmental factors. Microbial succession pattern showed higher prevalence of fungi (Fig. 2a) during summer months (pre-monsoon), taken over by general bacterial community

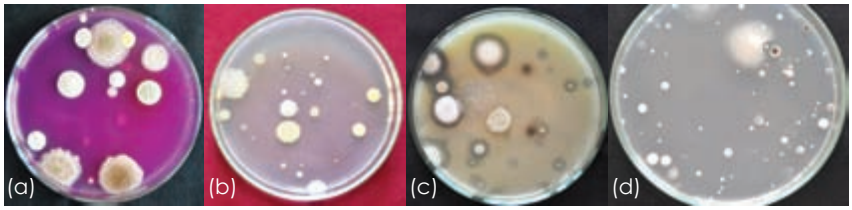


Fig. 2. Different groups of microorganisms enumerated in coconut rhizosphere soils in different seasons – (a) fungi, (b) bacteria, (c) phosphate solubilizers, (d) actinomycetes

(Fig. 2b) including phosphate-solubilizers (Fig. 2c) during the period of higher precipitation (monsoon), followed by a spurt in the population of fluorescent pseudomonads and nitrogen fixers after the rains receded (post-monsoon). Actinomycetes (Fig. 2d) group remained stable throughout with an occasional peak and dip during the wet and warm season, respectively.

Alka Gupta, Surekha, Murali Gopal and Ravi Bhat

Ecological tolerance of Kera Probio® bioinoculant

Kera Probio® is a talc-based bioinoculant recommended by ICAR-CPCRI for application in coconut seedlings to improve their health and vigour; which is produced by the institute and supplied to coconut farmers. After application, several environmental conditions impact its survival and performance in the field. Hence, conditions such as temperature, pH and salt levels for which it is best adapted were determined. The tolerance range of this bioinoculant (Fig. 3) for pH was found to be much narrower (6.2-8.2) than for temperature (15-50°C) and salt levels (0.5-10% NaCl). The results suggest the suitability of this bioinoculant even for salt-affected soils in high temperature zones. However, for acidic soils with pH<6.0, dolomite or lime application is desirable to correct the pH before application of this bioinoculant.

Alka Gupta and Murali Gopal

Fig. 3. Kera Probio bioinoculant

Performance of Alpinias and Bird of Paradise in coconut gardens – A pilot study

A field study was conducted at Regional Station, Kayamkulam during 2015-19 to evaluate the performance of selected Alpinia varieties and Birds of Paradise, *Sterletzia* sp. (BOP) in two growing conditions *i.e.* open, and as an intercrop in a coconut plantation. Four commercial varieties of Alpinia *viz*. Alpinia 'Red', Alpinia 'Pink', Alpinia 'Kimi' and Alpinia 'Jungle King' were planted. Studies revealed that 'Jungle King' is suitable for intercropping in coconut gardens. It produces flower throughout the year except during April-May. The inflorescences produced in these plants were of marketable standards. The adaptation of BOP in coastal humid tropics has shown no significant difference between an open and intercropped condition and took around 30 months for flower initiation in both the growing situations. The flowering season of BOP in this agro climatic conditions is from July to November where the maximum day temperature is below 31°C. Due to its long duration for flowering and less number of flowers per clump, it may not be a suitable intercrop under tropical conditions, in coconut gardens (Fig 4a, b).

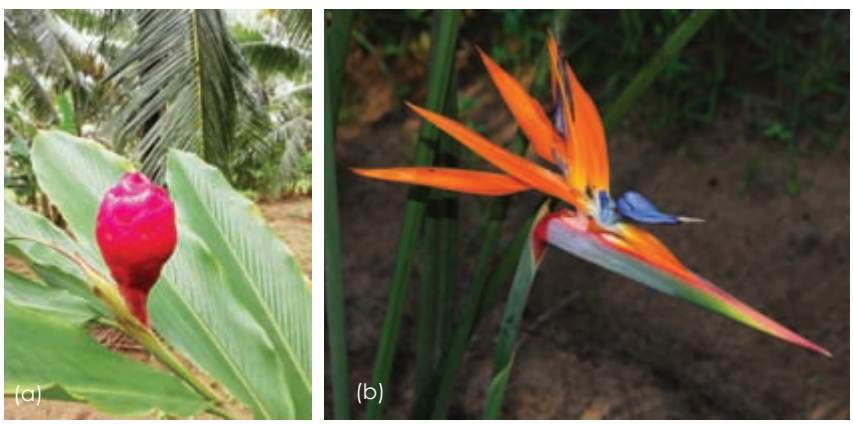


Fig. 4 a) Alpinia 'Jungle King' and b) Bird of Paradise intercropping under coconut garden at ICAR-CPCRI, RS, Kayamkulam

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

Composting of recalcitrant coconut husks

Growing awareness about organic crop cultivation is drawing cultivators towards manure production in their farms. In parallel, problem of safe disposal of tender coconut husks has led many to the institutes for a technology solution.

Fig. 5. First phase –Aerobic composting

Fig. 6. Second phase –Vermicomposting

Towards this end, our efforts have yielded a process wherein a two-stage approach is followed for composting of tender and mature coconut husks. The first stage involves aerobic composting using earthworm gut microbiota with organic amendments (Fig. 5) and the second phase uses *Eudrilus* sp., the coconut leaf vermicomposting earthworms (Fig. 6). The use of coconut husk compost produced this way, along with soils, when used as a potting mix to raise vegetables, showed improved soil moisture retention and increased microbial populations involved in nutrient mineralization in the growth medium.

Murali Gopal and Alka Gupta

NGS-based metagenomic analysis of coconut husk composts

Microbiomes of mature and tender coconut husk composts, produced using a semi-static composting process, were analyzed by sequencing of metagenomic DNA from composts using culture-independent method targeting the hypervariable region of the gene encoding for 16S ribosomal RNA. The sequencing methodology adopted allowed us to sequence both culturable and non-culturable microbes directly from compost samples, providing insight into the biomass degradation-related microbial community composition. The microbiomes of both matured and tender coconut husk composts consisted of distinctively higher OTUs of Actinobacteria, Bacteroidetes, Chloroflexi, Candidate Division TM7, Acidobacteria and Verrucomicrobia compared to uncomposted coconut husks (Fig.7). Candidate division TM7, now known as candidatus *Saccharibacteria*, though remains unculturable to date, got amplified during the composting process and is known to possess a very versatile carbon metabolism.

Murali Gopal and Alka Gupta

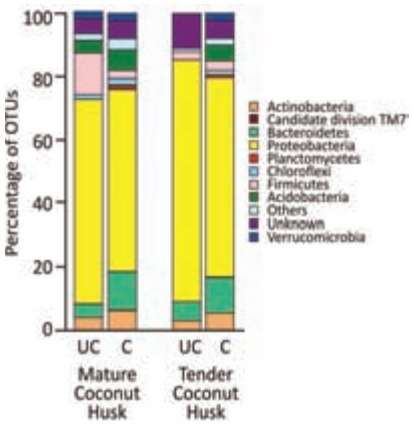


Fig. 7. Taxonomic assignment of bacterial phylain the coconut husk composts
(UC-Uncomposted; C-Composted)

Concurrent coincidence of three invasive whiteflies on coconut at Kayamkulam

Simultaneous coexistence of three invasive whiteflies *viz.,* rugose spiralling whitefly (*Aleurodicus rugioperculatus* Martin), Bondar's nesting whitefly (*Paraleyrodes bondari* Peracchi) and neotropical nesting whitefly (*Paraleyrodes minei* Iaccarino) was recorded on the undersurface of coconut leaflets for the first time in Kayamkulam, Kerala. Nesting whiteflies emerged prominence during the receding phase of the rugose spiralling whitefly about two years after its introduction in 2016 primarily accomplished through conservation biological control using the aphelinid parasitoid, *Encarsia guadeloupae*. This also marks the discovery of the exotic *P. minei* on coconut palms from Kerala, India identified through

Fig. 8a. *P. bondari*; b. *P. bondari* male genitalia; c. *P. minei* and male genitalia d. *P. minei*

morphological and molecular taxonomy. Forewings of *P. minei* are devoid of any markings as observed in *P. bondari*. Concurrent incidence of whiteflies is an anomaly to the ecological Gause's principle which states that 'no two organisms could occupy the same niche'.Nesting whiteflies construct nests similar to that of brooding nests of birds using fibre glass-like strands and sustain inside. Eggs are stalked and nymphs are flat with prominent strands on the dorsum. Male genitalia of *P. bondari* possess terminal apico-lateral process with dorsal and ventral projections whereas *P. minei* possesses cock-head like male aedeagus with long two caudal filaments. Strengthening quarantine is the need of the hour avoiding such accidental entry of alien invasive species into the country (Fig 8a, b, c, d).

Chandrika Mohan, Josephrajkumar, A., Merin Babu and Krishnakumar, V.

Discovery of a novel *Steinernema* sp. sustaining highest shelf life

A novel entomopathogenic nematode (EPN), *Steinernema* sp. CPCRI0804 recovered from Kayamkulam soils, Kerala has been found superior in terms of higher shelf life as well as its efficacy against red palm weevil grubs. The infective juveniles (IJs) evinced more than 75% survival even after nine months of storage at an ambient temperature maintained in distilled water. This is the first report of an EPN surviving for more than five months at ambient temperature without any additives.

Fig. 9. Entomopathogenic nematode (EPN), *Steinernema* sp.

This isolate was also found to be highly virulent against red palm weevil grubs under laboratory condition, which induced 100% mortality when applied @ 200 IJs/ grub. Natural occurrence of these EPN in this part of Kerala could be one of the reasons for the limited occurrence of white grub on native crops. (Fig. 9.)

Anes, K.M., Merin Babu, Josephrajkumar, A. Jinu Sivadasan and Chandrika Mohan

Phytobeneficial root endophytic *Bacillus* spp. of RWD resistant coconut palms

Root endophytes representing a selected fraction of rhizosphere microbial communities exhibit phytobeneficial traits responsible for growth promotion and stress modulation. Bacterial root endophytes from the fresh feeding roots of apparently healthy coconut palms were on an average of 2 x 10^3 cfu/g of fresh root sample (on trypticase soya agar). Seventeen bacteria with distinct colony morphotypes were screened for phytobeneficial traits. Of the seventeen, 9 bacteria produced indole acetic acid (IAA). Six of 17 bacteria grew on nitrogen (N) free media indicating their N fixing potential among which 4 were IAA producers. Seven isolates utilized ACC (aminocyclopropane carboxylate) as their sole N source indicative of their ACC deaminase activity, of which 4 had nitrogen fixation and 3 had IAA production potential (Fig. 10). On the basis of the above plant growth promoting (PGP) traits, 3 isolates CRE2, CRE9 and CFRE15 exhibiting most PGP traits were selected

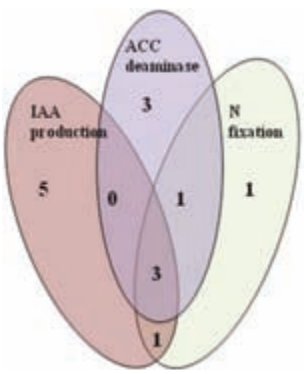


Fig. 10. Nitrogen fixing potential, IAA production, ACC deamination activities by different bacteria

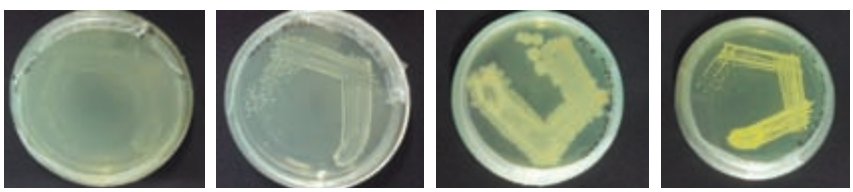


Fig. 11. Identification of bacteria from rhizosphere microbial isolation cultures

for further studies. All the three were positive for catalase and esculin hydrolysis and negative for indole, alkaline phosphatase, lysine, arginine decarboxylase and urease test. They were tentatively identified as *Bacillus* spp. on the basis of cultural, morphological and biochemical characteristics. Studies on endophytes of RWD resistant coconut palm in RWD tract are limited and remain a prospective strategy for root (wilt) disease management of coconut (Fig. 11).

Indhuja S, Anju R, Merin Babu, A. Abdul Haris, Krishnakumar V

Transition towards organic farming: An innovation system perspective

Having traced the current innovation system of the organic transition of the district, we have identified the weak linkages and neglected nodes as well as activities which entail the suboptimal functioning of the innovation system as a whole. In light of our field study and critical analysis of the scenario in a heuristic mode, we are providing a suggestive alternative redefining of the existing system towards a reoriented and transformed innovation frame for the optimal outcomes (Fig. 12). We propose the formation of an 'autonomous council', with appropriate representations from policy hub (state machinery), department of agriculture, research institutions and farmer organizations. To gain consumer confidence, the proposed organic council should work out the modalities for certification and labelling of the products available in the eco-shops in a cost-effective manner. In a phased manner the organic farmers (clusters) can be upgraded in the domestic organic products value chain, by linking the farmers' and products with the big buyers (chains) beyond the periphery of regional clusters, districts and even the state.

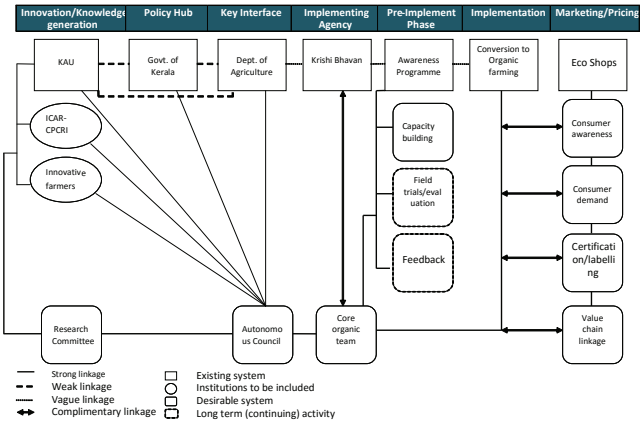


Fig. 12. Transition towards organic farming: A comprehensive depiction of Innovation System

Thamban C., Jayasekhar S. and Chandran K.P.

Important Events

Punarnava Kisan Mela - 2019

Punarnava Kisan Mela – 2019, KVK-ATMA Technology Meet and Agricultural seminars, were inaugurated by Shri E. Chandrasekharan, Hon'ble Minister for Revenue and Housing, Govt. of Kerala, at ICAR-CPCRI, Kasaragod on 16th February, 2019. Shri N.A. Nellikunnu, Hon'ble MLA, Kasaragod, Shri M. Rajagopalan, Hon'ble MLA, Thrikkaripur, Dr. Anitha Karun, Acting Director, ICAR-CPCRI, dignitaries from the LSGs, the Dept. of Agriculture, Govt. of Kerala and ATMA were present during the occasion. More than 40 exhibition stalls on agriculture were put up and about 300 stakeholders participated in the inaugural programme. The exhibition and seminars related to agriculture, horticulture, pisciculture, animal husbandry, value addition and various schemes related to agriculture were held till the closing ceremony on 19th February, 2019.

Shri E. Chandrasekharan, Hon'ble Minister for Revenue and Housing, Govt. of Kerala inaugurating Punarnava Kisan Mela at ICAR-CPCRI, Kasaragod

Kalpa Green Chat

An interactive meet was held on 24th January, 2019, Shri Nagraja Prakasam, fund adviser and investor delivered a lecture on 'Social startups' under Green Kalpa Chat. A breakfast meet-up was held in the presence of Dr. D. Sajith Babu IAS, District Collector, Kasaragod and Shri Nagraja Prakasam. Unemployed youth and enterprising stakeholders participated in the interactions. Dr. Anitha Karun, Act. Director, ICAR-CPCRI, officials of Malabar Innovation Zone and business/investor community of Kasaragod shared their views on evolving a congenial business and innovation system in the locality.

Farmers' meet and technological conclave

A technological conclave had been convened under the Farmer FIRST programme in Pathiyoor on 14th February, 2019. The conclave was presided by Shri V. Prabhakaran, President, Pathiyoor Grama Panchayat and inaugurated by Adv. U. Prathibha, Hon'ble MLA, Kayamkulam. Dr. Anitha Karun, Acting Director, ICAR-CPCRI, Kasaragod delivered the keynote address and highlighted that this FFP is rated as the best in the country in terms of scientific accomplishments. The programme had the focus towards Clean and Green Panchayat with the participation of more than 350 farmers.

Fifty years of remote sensing research

The first national initiative on remote sensing was attempted way back in 1969 at ICAR-CPCRI, Regional Station, Kayamkulam with the international collaborative project by Indian Space Research Organization, ICAR-Indian Agricultural Research Institute, New Delhi, ICAR-Central Plantation Crops Research Institute, Kasaragod and National Aeronautics and Space Administration, USA for the early diagnosis of root (wilt) disease in coconut. In this process, remote sensing tool through false infra-red aerial photography was employed using helicopter that had taken exposures in two different elevations of 500 and 1000 ft on a helicopter moving at a speed of about 100 km per hour. Due to weaker infra-red reflectance of root (wilt) diseased coconut palm as measured by microphotometer, the crown appeared pale whereas the crown of healthy palms appeared absolutely red.

In order to bring on to light unique reminiscence of the first attempt at Kayamkulam. Dr. Rabi N. Sahoo, National Coordinator, Division of Agricultural Physics, ICAR-IARI, New Delhi visited ICAR-CPCRI, Regional Station during 6-7 February, 2019. Dr. Sahoo could now take an overall aerial view of health and diseased coconut palms using Unmanned Aerial Vehicle (UAV) drone technology fitted with multi-spectral camera. The results of which as RGB photos could be visualized in a few hours and with the sophisticated softwares, further refinements are possible to picture out differences between healthy and diseased palms. Dr. Sahoo had given a talk on the technological advancements in remote sensing towards nutrition mapping and pest surveillance.

Visit of Expert team to coconut gardens in Mysore and Mandya

A scientific team visited various coconut gardens around Mysore and Mandya during 18-19 March, 2019 to assess the impact of the infestation of rugose spiralling whitefly (RSW). The infestation level was very low (1-5 colonies/ leaflet), but three different species of invasive whiteflies could be observed including rugose sprialling whitefly, nesting whitefly and new coconut whitefly. Indiscriminate use of insecticides was observed. Pesticide holiday approach and conservation biological control using the aphelinid parasitoid, *Encarsia guadeloupae* was stressed as a remedial measure. Inadequate nutrition, moisture stress and unscientific farming practices were recorded as the main reasons for poor yield. A sensitization campaign with the technical support of CDB was emphasized.

Research Advisory Committee meeting

The 21st Research Advisory Committee (RAC) Meeting was held during 27th-28th February, 2019. RAC meeting was chaired by Dr. H.P. Singh, Former DDG (Hort.Sci), ICAR. The members present were: Dr. P. Das, Dr. D.M. Hegde, Dr. S.R. Bhat, Dr. Anitha Karun, Shri. Suresh Kumar Shetty, Shri. Shivakrishna Bhat and Dr. K.B. Hebbar, Acting Head, Division of (PB&PHT) and Member Secretary. Scientists of ICAR-CPCRI, KVK-Kasaragod, KVK-Alleppey also attended the meeting. All the programme leaders presented the activities and achievements of ICAR-CPCRI during the year 2018-19. After detailed deliberations, RAC has recommended the following activities:

- Design and validate trait-specific markers based on available sequence data and genotyping by sequencing (GBS) approaches in coconut and arecanut,
- Initiate work on the construction of molecular linkage maps of coconut and arecanut using selfed/crossed populations,

- Studies on rainwater management both in high and low rainfall regions with emphasis on better conservation of soil moisture and use of harvested runoff to overcome moisture deficit in the dry season,
- Develop and promote integrated pest management module to contain and prevent the spread of invasive pest like spiralling whitefly,
- Evolve strategies used to prolong the shelf life of neera, tender nut water and kernel based products, and
- Assess the socio-economic impact of the technologies developed and adopted across the agro-ecological regions.

Dr. H.P. Singh, Chairman, RAC addressing the scientists at ICAR-CPCRI, Kasaragod

Workshop on transition in agriculture

A workshop on 'Transition in agriculture' was organized at ICAR-CPCRI, Kasaragod on 13th February, 2019. The workshop was organized in collaboration with the Haritha Kerala Mission as a part of the strategic initiative of organic district programme in Kasaragod district by the Department of Agriculture, Kasaragod under the Government of Kerala.


Dr. Sajith Babu IAS, District Collector, Kasaragod addressing the gathering at ICAR-CPCRI Kasaragod

Institute Research Committee Meeting

The 47th Annual Institute Research Committee Meeting of the Institute was held at ICAR-CPCRI Kasaragod during 18th – 22nd March, 2019. Progress of research programmes and achievements under the ongoing projects under Crop Improvement, Biotechnology, Crop Production, Integrated Disease Management, Integrated Pest Management, Physiology & Biochemistry, Value Chain Management, and Social Sciences including Transfer of Technologies from the two KVKs were presented in detail by the respective Principal Investigators.


Release of interactive DVD on rugose spiraling whitefly of coconut during the plenary session of IRC meeting at Kasaragod

The Plenary Session was held on 22nd March, 2019 under the chairmanship of Dr. Anitha Karun, Acting Director. The session was co-chaired by Dr. V. Krishnakumar, Head, ICAR-CPCRI, RS, Kayamkulam. Dr. Homey Cheriyan, Director, Directorate of Arecanut and Spices Development, Kozhikode and Dr. P.R. Suresh, Associate Dean, College of Horticulture, KAU, Padannakkad, Kerala, were the Guests of honour. During the meeting, progress of all the ongoing research projects (including externally funded projects) grouped under seven research programmes were discussed and the technical programme for the year 2019-20 was finalized.

Publications

Ajithkumar, P. and Samsudeen, K. 2018. Seasonal variation and developmental changes in the biochemical composition of coconut kernel in Mohachao narel, a sweet endosperm coconut (*Cocos nucifera* L.) population from Maharashtra. *Trends in Biosciences,* **11**(7): 1599-1603.

Ajithkumar, P. and Samsudeen, K. 2018. Seasonal variation in the fatty acid composition of oil from Mohachao narel, a sweet endosperm coconut (*Cocos nucifera* L.) population from Maharashtra. *Trends in Biosciences,* **11**(7): 995-1002.

Arivalagan, M., Roy, T.K., Yasmeen, A.M., Pavithra, K.C., Jwala, P.N., Shivasankara, K.S., Manikantan, M.R., Hebbar, K.B., Kanade, S.R. 2018. Extraction of phenolic compounds with antioxidant potential from coconut (Cocos nucifera L.) testa and identification of phenolic acids and flavonoids using UPLC coupled with TQD-MS/MS, *LWT - Food Science and Technology,* doi: 10.1016/j.lwt.2018.02.024.

Bhalerao, P.P., Maheswarappa, H.P., Sumitha, S., and Elain Apshara, S. 2018. Performance of cocoa clones as intercrop in coconut gardens under south Gujarat condition. *International Journal of Innovative Horticulture,* **7** (2): 120-122.

Chowdappa, P., Hebbar, K.B., Ramesh, S.V., 2018. Arecanut and Human Health. *Current Science,* **115** (6):1025-1026.

Elain Apshara, S. and Krithika, K.J. 2018. Evaluation of selective cocoa clones from Central and South America in their initial years of growth. *Journal of Plantation Crops,* **46**(3): 218-220.

Hebbar, K.B., Pandiselvam, R., Manikantan, M.R., Arivalagan, M., Shameena Beegum and Chowdappa, P. 2018. Palm Sap—Quality profiles, fermentation chemistry, and preservation methods. *Sugar Tech*. DOI: 10.1007/s12355-018-0597-z.

Jayasekhar, S. and Hughes, S.A. 2018. Sectoral equations of sustainability: Narrative of plantation sector in India. *Journal of Plantation Crops,* **46**(3): 210-217.

Jayasekhar, S. and Isaac Ndung'u. 2018. Review of economic history of cocoa with special reference to India. *Journal of Plantation Crops,* **46**(2): 133-138.

Jeena Mathew**,** V. Krishnakumar, V. Srinivasan, Ravi Bhat, Narayanan Nampoothiri, A. Abdul Haris. 2018. Standardization of critical boron in soil and leaves of coconut palms grown in a tropical Entisol. *Journal of Soil Science and Plant nutrition*, **18**(2):376-387.

Khadke, G.N., Niral, V., Kulkarni, M.S., Hegde, N.K., Sandhyarani, N., and Naika, M.B.N. 2019. Mean performance of the national and international coconut accessions for the yield attributing and nut quality traits. *International Journal of Current Microbiology and Applied Science,* **8**(2):2597-2606.

Murali Gopal and Alka Gupta. 2019. Building plant microbiome vault: a future biotechnological resource. *Symbiosis*, **77**(1): 1-8. *doi.org/10.1007/s13199-018-0574-z*.

Murali Gopal, Alka Gupta, K. Shahul Hameed, R. Chandra Mohanan and George V. Thomas. 2019. A simple, quick and contamination-free method for mass-multiplication of plant-beneficial microbes by small and marginal farmers using coconut water and rice gruel medium. *Indian Journal of Agricultural Sciences,* **89**(2): 339–343.

Muralikrishna, K.S., Sabana, A.A., Midhuna, K., Anitha Karun and Rajesh, M.K. 2018. DNA extraction method from endosperm of *Areca concinna* Thwaites, a wild relative of arecanut. *International Journal of Innovative Horticulture*, **7**(1):50-53.

Muralikrishna, K.S., Sharadraj, K.M., Gangaraj, K.P., Nagaraja, N.R., Anitha Karun, Rajesh, M.K. and Chowdappa, P. 2018. *In vitro* assay for screening of *Areca* spp. for *Phytophthora* resistance. *International Journal of Innovative Horticulture*, **7**(2):139-142.

Research Articles

Nair K.M., Abdul Haris, Jeena Mathew, Srinivasan,V., Dinesh, R., Hamza, H., Subramanian, P., Thamban, C., Chandran, K.P., Krishnakumar, V., Ravi Bhat, Hegde, R., and Singh. S.K. 2018. Coconut-growing soils of Kerala: 2. Assessment of fertility and soil related constraints to coconut production. *Journal of Plantation Crops*. **46**(2): 84-91.

Nihad K., Krishnakumar, V., Abdul Haris, A., Ravi Bhat and Chowdappa, P. 2018. Heliconias: A potential intercrop in coconut ecosystem. The Bulletin - *A Journal of the Zingiberales Heliconia Society International*. **24**(4): 8-9.

Prathibha, P. S., Kumar, A. R. V., Subaharan, K. and Vibina Venugopal. 2018. Influence of abiotic factors on adult emergence pattern of coconut white grub, *Leucopholiscoeneophora* Burm. (Scarabaeidae: Melolonthinae: Coleoptera) *Phytoparasitica*. **46**(3) :341 – 353.

Prathibha, V.H., Vinayaka Hedge, Sharadraj, K.M., Rajesh, M.K., Rachana, K.E. and Chowdappa, P. 2018. Differentiation of *Phytophthora* species associated with plantation crops using PCR and high-resolution melting curve analysis. *Journal of Plant Pathology,* **100**(2): 233-240.

Rachana, K.E., Gangaraj, K.P. and Rajesh, M.K. 2018. Characterization, structural modeling and docking study of CnCNLR1, a CC-NBS-LRR protein from coconut. *International Journal of Pure and Applied Biosciences*, **6**(3):137-145.

Rajesh M.K., Rachana K.E., Kulkarni K., Sahu B.B., Thomas R.J. and Karun A. 2018. Comparative transcriptome profiling of healthy and diseased Chowghat Green Dwarf coconut palms from root (wilt) disease hot spots. *European Journal of Plant Pathology*, **151**(1): 173-193.

Rajkumar, Srinivas Reddy and M. Nagesh 2016.Occurrence of *Meloidogyne incognita* infecting papaya. *Indian Journal of Nematology*, **46** (1): 81.

Sabana, A.A., Ginny Antony, Rahul, C.U. and Rajesh M. K. 2018. *In silico* identification of miRNAs and their targets associated with coconut embryogenic calli. *Agri Gene,* **7:** 59-65.

Shareefa, M., Thomas, R. J. and Nampoothiri, C. K. 2018. Standardization of seednut storage techniques for Kalpasree variety of coconut. *Indian Journal of Horticulture* **75**(4): 728-731.

Srinivasan, T., Rajamanickam, K., Chandrika Mohan,and. Maheswarappa H.P. 2018. Validation of integrated pest management strategy against coconut rhinoceros beetle, *Oryctes rhinoceros* L. (Scarabaeidae: Coleoptera) *J. Plantn. Crops*, 2018, **46**(1): 8-11.

Sujatha, S. Bhat Ravi and Elain Apshara, S. 2018. Climate change, weather variability and associated impact on arecanut and cocoa in humid tropics of India. *International Journal of Innovative Horticulture*. **7**(1): 27-37.

Thube, S. H., Chandrika Mohan, Pandian, R.T.P., Saneera, E. K., Sannagoudra, H. M. Vinayaka Hegde and Chowdappa P. 2018. First Record of the Invasive Neotropical Ambrosia Beetle *Euplatypus Parallelus* (Fabricius, 1801) (Coleoptera: Curculionidae: Platypodinae) Infesting Arecanut in Karnataka, India. *The Coleopterists Bulletin* **72**(4): 713-717. https://doi.org/10.1649/0010-065X-72.4.713.

Alka Gupta, S. Indhuja, K.B. Vrinda and M Gopal 2018. Diversity of macrofungi in coconut ecosystem. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 126.

Anitha Karun, Jyothisha K.V., Muralikrishna K.S., Sajini K.K. and Rajesh M.K. 2018. Cryopreservation of cocoa shoot tips using V-cryomesh and D-cryomesh methods. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 54.

Anitha Karun, Kavya P., Muralikrishna K.S., Sajini K.K., Afeeda K.T. and Rajesh M.K. 2018. Effect of carbon nanoparticles in the cryopreservation of coconut zygotic embryos by vitrification. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 52.

Research Articles

Papers Presented

Aparna V., Krishna Prakash, Neema M., Muralikrishna K.S., Samsudeen K. and Anitha Karun 2018. Pollen preservation at low temperature: An efficient short term storage method in coconut. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 38.

Chandran K.P., C T Jose, K. Muralidharan, Jayasekhar and Sandip Shil 2018. Crop insurance in plantation crops- Where do we stand? *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 154.

Devakumar K., Regi Jacob Thomas and Anitha Karun. 2018. A durable pollination raincoat for coconut hybridisation during monsoon. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 11.

Gangaraj K.P., Rajesh M.K., Prathibha, V.H. and Vinayak Hedge. 2018. Identification of RxLR effectors in coconut bud rot pathogen *Phytophthora palmivora* though dual transcriptomics study. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 43.

Gayathri U Karkera and Niral V. 2018. Sprouting characteristics and seedling traits in a core set of coconut germplasm. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 16.

GeethuVenugopal, K.P. Gangaraj, K. S. Muralikrishna and M.K. Rajesh. 2018. Core reactions of fatty acid biosynthesis in coconut reconstructed based on assembly and annotation of genome and transcriptome data. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 53.

Indhuja S, Anju R., Merin Babu, A.A.Haris, Krishnakumar, V. 2018. Phytobeneficial root endophytes of root (wilt) disease resistant coconut palm. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 123.

Jayasekhar S, and Chandran, K.P. 2018. Domestic value chain of arecanut in India: Traversing uncertainties *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 156.

Jayasekhar S, Chandran K P, Thamban C and Muralidharan K. 2018. Sustainable plantation crops for inclusive growth: Indian scenario, issues, challenges, and coping strategies. *Agricultural Economics Research Review*. 31(Conference Number) 2018: 241.

Jayasekhar S, Chandran K.P., Thamban C., and Muralidharan K. 2018. Coconut sector in India experiencing a new regime of trade and policy environment: A critical analysis *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 152.

Jeena Mathew, A. Abdul Haris, Chinchu M Raj, V.Krishnakumar, Ravi Bhat, K. Muralidharan and Susan John 2018. Nutrient partitioning in root (wilt) disease affected vis- a-vis healthy coconut palms grown in an Entisol of humid tropics. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 80-81.

Khadke, G. Niral V., Kulkarni, M. S., Sandhyarani, N. 2018. Coconut var. Spicata specific molecular markers: identification and validation. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 14.

Krishna Prakash, Aparna V, Neema M, Muralikrishna K S,Sabana A A, Rajesh M K and Anitha Karun. 2018. Somatic embryogenesis and plantlet regeneration from immature inflorescence explants

in arecanut dwarf hybrids. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 42.

Krishnakumar, V., Jeena Mathew., Abdul Haris, A., Ravi Bhat and Nair, K.M. 2018. Soil fertility management in coconut based land use system. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 64-65.

Mathew A C, C Thamban, Manoj P Samuel, S Jayasekhar and P Muralidharan 2018. Effect of terracing and vegetation on water erosion in the hilly tracks of Western Ghats. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 78.

Murali Gopal and Alka Gupta 2018. An easy 'push-pull/pull-pull' method to harvest earthworms from coconut leaf vermicomposting units. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 106.

Murali Gopal and Alka Gupta. 2019. Plant microbiome: a novel toolbox for sustainable agriculture. *In:* National Conference on Novel Microbial Technologies for Sustainable Agriculture and Allied Industries (NMTSAAI-2019), Annamalai University, Tamil Nadu, Jan. 28-29, 2019, pp. 9-10, Book of Abstracts.

Murali Gopal, Alka Gupta and P. Chowdappa. 2019. 'Carbonobiome' addition *via* recycled coconut palm residues can reinvigorate soil health and engender regenerative agriculture. *In* XIV Agricultural Science Congress- Innovation for Agricultural Transformation 2019, New Delhi, Feb. 20-23, 2019, pp.44, Book of Summary-Lead and Session Lectures.

Murali Gopal, Alka Gupta, K. Shahul Hameed, R. Chandra Mohanan and George V. Thomas 2018. Farmer-enabled mass-multiplication of plant-beneficial microbes using coconut water and rice gruel medium. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 89.

Nagaraja N.R. 2018. Polyembryony in Areca catechu L. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 20.

Nagaraja N.R., K.S. Ananda and M.K. Rajesh. 2018. Assessment of genetic diversity in arecanut germplasm using SSR markers. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 57.

Nagaraja N.R., S.V. Ramesh, M. Arivalagan, C.H. Sushmitha, K.B. Hebbar, Bhavishya, K.S. Ananda and P. Chowdappa. 2018. Variegations in Areca catechu L. (var. Mangala and South Kanara Local)-A case study. Oral presentation in International Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences (GRISAAS-2018). In: souvenir and conference book, S.P. Singh (Chief Editor). Pp.39-40. 28th to 30th October 2018, Rajasthan Agricultural Research Institute (RARI), Durgapura, Jaipur, Rajasthan, India.

Nagaraja, N. R., Niral, V. and Chowdappa, P. 2018. Compendium of abstracts. Workshop on Breeding Strategies in Plantation Crops. ICAR-CPCRI, Regional Station, Vittal. 27th April 2018. 19 pp.

Nagaraja, N.R., Ramesh S.V., Arivalagan, M., Sushmitha, C.H., Hebbar, K.B., Bhavishya, Ananda, K. S., Chowdappa P. 2018.. Variegations in *Areca catechu* L. (var. Mangala and South Kanara Local) - A case study**.** *In* Proceedings ofInternational Conference on Global Research Initiatives for Sustainable Agriculture and Allied Sciences Rajasthan Agricultural Research Institute, Jaipur, Rajasthan. pp39-40.

Namitha M.S., Gangaraj K.P., Muralikrishna K.S., Rajesh M.K. and Anitha Karun 2018. Mining of core cell cycle linked genes in coconut genome. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et*

al. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 55.

Neema M. , G.S. Hareesh, V. Aparna, Krishna Prakash, K. P. Chandran and Anitha Karun. 2018. Electrical induction enhances the callus growth in plumular explant of coconut (*Cocos nucefera*) *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 44.

Neenu S, Selvamni, V, Paulraj, S and Ravi Bhat 2018. Inorganic Phosphorus Fractions and Phosphorus Availability in Long term fertilizer cum Manurialtrails under Coconut cultivation. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 79.

Nihad K., A.Abdul Haris,V. Krishnakumar,Jeena Mathew, Indhuja S and Neenu S. 2018. Integrated nutrient management for Hybrid Bajra Napier in coconut based farming system. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 68-69.

Prathibha P. S., Rajesh M. K., Sabana A. A. Rachana K. E. And KesavanSubaharan 2018. Distinguishing palm white grub complex, Leucopholis spp. (Coleoptera: Scarabaeidae: Melolonthinae) using high resolution melting (HRM) analyses. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 107.

Prathibha V.H., Vinayaka Hegde, Gangaraj K. P. and Rajesh M. K. 2018. *Lasiodiplodia theobromae* responsible for severe dieback disease on cocoa in Andhra Pradesh & Kerala regions, IndiaBook of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 122.

Priya George, Alka Gupta, Murali Gopal, Litty Thomas, George V. Thomas. 2018. Elite plant growth promoting rhizobacteria from coconut: their growth promotion potential, molecular and phenotypic characterization. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 87.

Rajesh M.K., Muralikrishna K.S., Swapna S. Nair, Subrahmanya T.M., Subaharan K. 4 and Anitha Karun 2018. Coconut inflorescence sap (KalparasaTM) mediated synthesis of silver nanoparticles and antimicrobial properties in arecanut *in vitro* cultures. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23*rd* Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 67.

Rajkumar, Jaganathan D., Shivaji Thube, Harsha K., Sujithra M and Vinayaka Hegde 2018. Application of Steinernema carpocapsae aqua formulation for integrated management of white grub infestation in arecanut gardens of Western Ghats from Karnataka, India. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 96.

Ramesh S.V, Manikantan M.R., Pandiselvam R., Hebbar K.B. 2018.. Virgin coconut oil (VCO) manufacturing and quality aspects. *In* Proceedings of National Conference for Virgin Coconut Oil (VCO) held at CSIR-Central Food Technological Research Institute on 26-Dec-2018.

Ramesh S.V., Hebbar K.B., Rajesh M.K., Archana P. 2018. Soil water-deficit differentially modulates the expression of stress associated genes (SAGs) of *Cocos nucifera* L. seedlings with contrasting water-use efficiency (WUE). *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 93.

Ramesh S.V., K.B. Hebbar, Neenu S, Rajesh M.K 2018. Expression dynamics of nutrient transporter genes of *Cocos nucifera* L. grown in soil and aerated static-solution culture. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 9.

Papers Presented

Ramesh, S.V., Arivalagan M., Hebbar K.B. 2018..Coconut: A treasure trove of nutrition and health benefits. *In* Proceedings of CAFT on Biochemistry of Food crops: From omics studies to nutrient analysis held from 25-Sep-2018 to 15-Oct-2018.

Sabanaa A.A.,Gangaraj K.P., Rajesh M.K. and Ginny Antony. 2018. In silico prediction of long non-coding RNAs associated with coconut embryogenic calli. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 44.

Santhi C.K.V., Gangaraj K.P. and Rajesh M.K. 2018. Genome-wide identification of auxin response factor (ARF) gene family in coconut (*Cocos nucifera* L.). *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 51.

Shafeeq Rahman and Rajesh M.K. 2018. Molecular dissection of gibberellic acid biosynthesis machinery in coconut: From comparative genomics to differential expression profiling. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 48.

Shareefa M..,Regi. J. Thomas, J.S. Sreelekshmi and Anitha Karun. 2018. Occurrence of in vitro flowering in coconut (Cocos nucifera L). *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 18.

Singh L.S., Alpana Das, V. Niral and G.C. Acharya. Participated and presented poster on Study on flowering behavior of some local coconut genotypes under Assam condition in the 8th Indian Horticulture Congress, 2019 held at Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh from 17th to 21st January, 2019.

Subramanian P., R. Surekha, V. Selvamani, Alka Gupta, S. Neenu and Ravi Bhat 2018. Effect of different nutrient management practices on fodder yield of hybrid Bajra Napier var. CO5 grown as intercrop in coconut. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 73.

Sudha R., V. Niral,Y. Diwakar, M.K. Rajesh and K. Samsudeen. 2018. Genetic variability studies in a population of West Coast Tall coconut. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 12.

Sujithra M., V.H. Prathibha, Rajkumar and Vinayaka Hegde 2018. First report of Simplicillium sp, infesting rugose spiralling whitefly, *Aleurodicus rugioperculatus*. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 113.

Thamban, C., Jayasekhar, S., Chandran, K.P., Leena, S. and Jesmi Vijayan 2018. 'Friends of Coconut Trees' for Sustainable Coconut Development – Field Level Experiences and Impact of an Innovative Capacity Building Initiative for Rural Youth. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 149.

Thomas, R.J., Shareefa, M., Rajesh, K.S., Ganesh Khadke2 and Niral,V. 2018. Refining ground pollination technique for hybridization in coconut (*Cocos nucifera* L.). *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 17.

Vinayaka Hegde, Prathibha V.H., Thava Prakash Pandian R. and Chowdappa P. 2018. Alternate fungicide for the management of fruit rot disease of arecanut. *In:* Patil, S., Roobak Kumar, A., Krishna Reddy, P. *et al*. (Eds.). Book of Abstract, 23rd Plantation Crops Symposium, 6-8 March, 2019, Chikkamagaluru, Karnataka. Pp. 127.

Papers Presented

Anithakumari, P., V. Krishnakumar and Chowdappa, P. 2019. E kalpa: coconut information on your fingertips. Indian Coconut Journal. LX1(9): 14-17.

Anithakumari, P, Nagaraja N.R., Arun Kumar Sit, Indhuja. S, Chowdappa P.and Krishnakumar, V. 2018. Enabling inclusiveness and integration of knowledge systems through ICT among small and marginal farmers. AFITA/WCC 2018,October 24-26, e proceedings ' Research Frontiers in Precision Agriculture', International conference Organized by CSRE, Indian Institute of Technology (IIT), Powai, Mumbai.ISBN 9789388237130. Pp: 441- 443.

Bhat Ravi and Subramanian, P. 2018. Integrated farming for doubling the income (in Kannada). Negila Midita. **4**(10): 16-18.

Chandrika Mohan, Josephrajkumar, A., Merin Babu, Arya Krishna and Krishnakumar, V. 2019. Occurrence of Invasive Bondar's Nesting Whitefly on coconut in Kerala. *Indian Cocon. J.* **61**(9): 17-18.

Chandrika Mohan, Josephrajkumar, A., Singh, L.S. and Alpana Das 2018. New Distributional Record of rugose spiralling whitefly on coconut in Kamrup and Nalbari districts of Assam. *Indian Cocon. J.* **61** (4): 19-21.

Jeena Mathew, Krishnakumar, V.,Haris, A.A. 2018. Sub soil constraints and their management for sustainable coconut productivity**.** *E-Kerala Karshakan,* **6** (6):26-30.

Jissy George. 2018. Value added products from ginger. *Karshakashree,* **25**(1): 90.

Jissy George. 2019. Cooling squashes for Summer time. *Karshakashree,* **25**(3): 98.

Jissy George. 2019. Drying of vegetables for vattal production. *Karshakashree,* **25**(2): 90.

Jissy George., Anju, K.A. and Muralidharan, P. 2019. Value added products from vegetables. *Kerala Karshakan*, **64**(7). 22 – 23.

Jissy George., Anju, K.A., Muralidharan, P. 2019. Income generation from Banana Products. *Kerala Karshakan*, **64**(6). 39-40.

Josephrajkumar, A., Chandrika Mohan, Merin Babu, Arya Krishna and Krishnakumar, V. 2019. Bondar's Nesting Whitefly, *Paraleyrodes bondari* Peracchi –Yet another invasive pest recorded on coconut from India. *eKerala Karshakan,* **6**(7): 29-30.

Kalavathi, S., Chandrika Mohan and Thamban, C. 2018. Technology support for plant protection campaign in coconut. *Indian Coconut Journal,* **61** (2): 10-14.

Kalavathi, S., Haris, A.A., Mathew, J. and Krishnakumar, V. 2018. Farmer adaptations: Key for ecological sustainability. *Leisa India,* **20** (4): 6-9.

Lekha, G. and Muralidharan, P. 2019. "Mahima" – reaching new heights. *Krishijagaran*. **3**(3). 52 – 53.

Lekha, G., Muralidharan, P. 2018. Tomato grafts to resist bacterial wilt. Karshakasree, **24**(12), 32.

Muralikrishna H. 2019. Arecanut tender nut dropping. *Karaval Daily*, 2nd March, 2019, p 2.

Ravi, S., Muralidharan, P. 2018. CO(FS)8 cowpea: A good leguminous fodder grass for livestock.. Karshakasree, **24**(12), 133.

Ravi, S., Nithya, K.R.and Muralidharan, P. 2019. Substitute for livestock fodder in summer season. *Karshakasree*. **25**(2), 76.

Samsudeen K. and Thamban C. 2019. Farm conservation and utilization of coconut diversity, *Indian Coconut Journal*, **61** (10) 5-10.

Sit, A.K. 2019. Maslar rajar chase hat pakachchhe Uttoro. *The Anandabazar Patrika*, 28 March, p 4.

Sivakumar, T., 2018.. Maanium Manushyanum sheemakonna. *Karshakan* **2**(9): 42-44.

Thamban, C. 2018. Jalajeevanathinte anantha sadhyathakal (in Malayalam). In: Rajatham-

Popular Articles

Popular Articles

Silver Jubilee Souvenir of Decentralised planning. Kerala Institute of Local Administration (KILA), Thrissur and Kasaragod District Planning Committee. pp: 39-52.

Thamban, C. 2018. Susthira kera vikasanam-Sadhyathakalum sameepanangalum. *Indian Nalikera Journal*. **9**(8): 12-17.

Thamban, C. and Jayasekhar, S. 2018. Evolving a sustainable coconut sector in Kerala: prospects and perspectives. *Indian Coconut Journal*. **61**(5):25-29

Thamban, C. and Jesmi Vijayan. 2018. Coconut farming can be remunerative-Kerakesari K.T.Francis. *Indian Coconut Journal*. **61** (7):17-19.

Thamban, C. and Jesmi Vijayan. 2018. Ezhupathiyarilum thengu kayattam Ammadinte arogyarahasyam. *Indian Nalikera Journal*. **9** (8): 20.

Thamban, C., Chandrika Mohan., Jesmi Vijayan. and Ravindran, P. 2018. Nalikera vila samrakshanam karyakshamamakkan pankalitha vijnana vyapana padhathi. *Indian Nalikera Journal*. **9** (10): 5-6.

Thamban, C., Mathew, A. C., Subramanian, P. and Jayasekhar, S. 2018. Functional linkages and stakeholder interface for improved performance and sustained use of microirrigation technology in coconut farming. *Indian Coconut Journal*. **61** (7): 6-8.

Thamban, C., Subramanian, P. and Jayasekhar, S. 2018. Pralayabhathitha pradeshangalile thengin thottangalude paripalanam. *Indian Nalikera Journal*. **9** (10): 34.

Thamban, C., Subramanian, P. and Jayasekhar, S. 2018. Management of coconut garden during rainy season. *Indian Coconut Journal*. **61** (3): 4-8.

Book chapters

Anithakumari, P and Remya, L. 2019. Database of FFP participant farmers. Published by Director, ICAR CPCRI, January 2019. Pp.40.

George V. Thomas, Krishnakumar, V. Dhanapal, R. and Srinivasa Reddy, D.V. 2019. Agro management practices for sustainable coconut production. *In:* The Coconut Palm (Cocos nucifera L.) - Research and Development Perspectives: (Chief Editor-K.U.K.Nampoothiri, Editors-V. Krishnakumar, M.A.Nair and P.K.Thampan), Springer International Publishing, AG Switzerland. pp: 227-322.

Hameed Khan, H. and Krishnakumar, V.2019. Soil Productivity and Nutrition. In: *The Coconut Palm (Cocos nucifera L.) - Research and Development Perspectives*: (Chief Editor- K.U.K.Nampoothiri, Editors-V. Krishnakumar, M.A.Nair and P.K. Thampan), Springer International Publishing, AG Switzerland, pp: 323-442.

Josephrajkumar, A., Chandrika Mohan, Prathibha, P.S., Rajkumar, Nalinakumari, T. and Nair, C.P.R. 2019. Pest dynamics and suppression strategies. In: *The Coconut Palm (Cocos nucifera L.) - Research and Development Perspectives (*Chief Editor-K.U.K.Nampoothiri, Editors-V. Krishnakumar, M.A.Nair and P.K. Thampan), Springer International Publishing, AG Switzerland, pp: 557-634.

Manikantan, M.R., Shameena Beegum, Pandiselvam, R. and Hebbar, K.B. 2018. Entrepreneurship Oriented Processing and Value Addition Technologies of Coconut. In: Entrepreneurship and Skill Development in Horticultural Processing, 237-268, (Eds. Sudheer, K.P. and Indira, V.), New India Publishing Agency, New Delhi. pp. 432.

Sairam, V and Jayasekhar, S. 2018. World coconut economy: Sectoral issues, markets and trade. In The coconut palm (*Cocos nucifera* L.)-Research and development perspectives (eds. Nampoothiri, K.U.K., Krishnakumar, V., Thampan, P.K. and Nair, M.A.), Springer International Publishing AG Switzerland pp: 801-819

Thomas, R. J., Shareefa, M. and Nair, R.V. 2019. Varietal resistance in coconut. In: *The Coconut Palm (Cocos nucifera L.) - Research and Development Perspectives* (eds. Nampoothiri, K.U.K., Krishnakumar, V., Thampan, P.K. and Nair, M.A.), Springer International Publishing AG Switzerland pp: 157-190.

Book

Nampoothiri, K.U.K., Krishnakumar, V., Nair, M.A. and Thampan, P.K. 2019. The Coconut Palm **(***Cocos nucifera* L.) - Research and Development Perspectives, Springer International Publishing, AG Switzerland. 834 p.

Technical Bulletins

Elain Apshara, S., Purandhara C, Sandhesh M and Deppashri, Y. 2018. *Cocoa to Chocolate (Kannada)*. Technical bull no.140, CPCRI, Kasaragod and DCCD, Kochi,13 p.

Elain Apshara, S., Venkatesh Hubballi, N. and Alpana Das 2018. *Calendar for Cocoa- Assamese (Cocoa Khetir Mahili Panji)*. Technical bulletin 130, CPCRI, Kasaragod. 30 p.

Nagaraja N.R., and V. Niral. 2019. Thengina sudharitha thaligalu mattu sankaranagalu (Kannada). Technical bulletin No. 141. ICAR-CPCRI, Kasaragod, Kerala. 34 p.

Extension Folders

CPCRI. 2018. Pest and disease management in coconut – multicolor handout in *Malayalam.*

Rajkumar, Jaganathan D., Shivaji Thube, Chandrika Mohan, Josephrajkumar A., Leena S. and Vinayaka Hegde. 2018. Entomopathogenic nematode (EPN) for the management of root grub in arecanut. Extension handout, ICAR- Central Plantation Crops Research Institute, Kasaragod. 2p.

Rajkumar, Jaganathan D., Chandrika Mohan, Leena S., Josephrajkumar A., Vinayaka Hegde and Radhakrishnan V. 2018.*Mitra nimavirakalilude kavungile verutheeni puzhukkale niyanthrikkam* (in Malyalam). Extension folder No. 265, ICAR - Central Plantation Crops Research Institute, Kasaragod. 6p.

Ravi, S. and Muralidharan, P. 2019. Scientific feeding of cows. ICAR–KVK– Alappuzha, CPCRI, RS, Kayamkulam. 28p.

Sajnanath, K. and Muralidharan, P. 2019. Production and use of organic manures**.** ICAR–KVK–Alappuzha, CPCRI, RS, Kayamkulam. 24p.

Training Manual

Bhat Ravi and Subramanian, P. (Editors). 2018. Training Manual on Coconut Based Integrated Farming System (MANAGE Off-Campus Training Programme). ICAR-CPCRI, Kasaragod. P. 139.

Bhat Ravi, Karthika, K.S. and V. Selvamani. 2018. Role of soil testing in sustainable agriculture, In: Training manual on 'Hands on training in soil testing and fertilizer recommendations'. (Eds. Selvamani, V and Neenu, S.). pp.1-5. ICAR-CPCRI, Kasaragod.

Bhat Ravi, Selvamani, V. and Jeena Mathew. 2018. Nutrition and Palm Health. In: Training Manual on Integrated Pests and Disease Management in Coconut (Eds. Rajkumar, V. H. Prathibha and M. Sujithra). pp. 5-16.

Bhat Ravi, Selvamani, V. and Karthika K.S. 2018. Importance of soil test based fertilizer recommendation for arecanut and cocoa, In: Training manual on 'Hands on training in soil testing and fertilizer recommendations'. (Eds. Selvamani, V and Neenu, S.) pp.50-56. ICAR-CPCRI, Kasaragod.

Bhat Ravi, Subramanian P., Selvamani V. and Neenu S. 2018. Nutrient management in coconut based farming system – Concept and practices. In: Training Manual on Coconut Based Integrated Farming System (Eds. Ravi Bhat and P. Subramanian). pp. 36-55. ICAR-CPCRI, Kasaragod.

Training Manual

Bhat Ravi. 2018. Agronomic Practices for Enhancing Kalparasa Yield. In: Training manual on Kalprasa - Tapping and Value Addition. (Eds. M. R. Manikantan, R. Pandiselvam and P. P. Shameena Beegum). pp. 39-45. ICAR-CPCRI, Kasaragod.

Josephrajkumar, A., Chandrika Mohan and Anes, K.M. 2018. Innovative Approaches in Pest Management. *In: MANAGE Off-campus Training Manual on Integrated Pest and Disease Management in Coconut.* (Eds.) Rajkumar, Prathibha, V.H. and Sujithra, M., 24-28th April, 2018, pp 56-61.

Josephrajkumar, A., Chandrika Mohan, Merin Babu and Anes, K.M. 2018. Biodiversity and Biosecurity Risks in Coconut. *In: MANAGE Off-campus Training Manual on Integrated Pest and Disease Management in Coconut.* (Eds.) Rajkumar, Prathibha, V.H. and Sujithra, M., 24-28th April, 2018, pp 67-75.

Interactive DVD

Joseph Rajkumar A., Chandrika Mohan, Asokan E.R and Sajjan Medayil. 2019. Bio-suppression of rugose spiralling whitefly Video produced by Dr. Anitha Karun and Dr. V. Krishnakumar, ICAR-CPCRI 7 min.

Human Resources Development

Training Attended

Mr. Khadke Ganesh Navanath, Scientist, from CPCRI, RC, Kidu attended the training programme on "Analysis of Experimental Data by using R" at ICAR-NAARM, Hyderabad during 21st-26th February, 2019.

Shri K.N. Pankajakshan, Sr. Technical Assistant (Vehicles) has undergone a training on `Automobile maintenance, road safety and behavioural skills at ICAR-CIAE Bhopal during 16th - 22nd January, 2019.

Awards

The research paper entitled "Influence of crop combinations and soil factors on diversity and association of arbuscular mycorrhizal fungi in arecanut based cropping systems" by K. Ambili, George V. Thomas, Murali Gopal and Alka Gupta, in the Journal of Plantation Crops, received Dr. C. S. Venkataram Memorial Award for the best research paper of the biennium 2016-2018 during the 23rd PLACROSYM held at Chikkamagaluru on 6thMarch, 2019.

Dr. P. Chowdappa, President, ISPC, presenting the award to Dr. Murali Gopal and Dr. Alika Gupta, Principal Scientists, ICAR-CPCRI at Chikkamagaluru

Dr. R.L. Narasimha Swamy Memorial Award for the best original research paper was awarded for the team of Jeena Mathew, A. Abdul Haris, Chinchu M. Raj, Krishnakumar, V., Ravi Bhat., Muralidharan, K. and Susan John for the paper entitled "Nutrient partitioning in root (wilt) disease affected *vis a vis* healthy

coconut palms grown in an Entisol of humid tropics" presented at the 23rd PLACROSYM held at Chikkamagaluru during 6-8th March, 2019.

Dr. Jayasekhar S, Sr. Scientist (Ag. Econ) received the 'Best Arecanut Scientist Award" instituted by All India Supari (Betelnut) Federation Trust through the Indian Society of Plantation on 6th March 2019 for his contributions towards the socio-economic and policy oriented research on arecanut sector in India.

Dr, Jeena Mathew receiving the Dr. R.L. Narasimha Swamy Memorial Award


Dr. Jayasekhar receiving Best Arecanut Scientist award from Dr. P. Chowdappa, President, ISPC at Chikkamagaluru

Ph.D. awarded

Jilu V. Sajan has been awarded Ph.D. degree from, ICAR-Indian Agricultural Research Institute (IARI), New Delhi for her thesis entitled 'Trapping activity of volatiles from symbiotic bacteria of melon fruit fly, *Bactrocera cucurbitae* (Coquillett)' under the guidance of Dr. Kirti Sharma, Principal Scientist, Division of Entomology, IARI, New Delhi

Transfer of Technology

On - campus Trainings

Training programme on EPN mass production

Training women entrepreneurs in the process of mass production of entomopathogenic nematodes and host insect *Galleria mellonella* was conducted under the Nileshwar Krishi Bhavan, Kasaragod on 28th August, 2018 and under the Varanashi Organic Manures commercial firm, Dakshina Kannada, Karnataka on 14th March, 2019 at ICAR - CPCRI, Kasaragod. They were trained on mass production of *Steinernema carpocapsae* (CPCRI - SC1) and *Heterorhabditis inidica* (CPCRI - HI1) in *Galleria* larvae of aqueous and cadaver formulation and


View of participants on EPN training from Nileshwar panchyath, Kasaragod


Hands on training to staff at Varanashi firm on EPN mass production


Women entrepreneurs at the EPN mass production unit at Nileshwar block Panchyath Krishi Bhavan, Kasaragod

culture maintenance. Twenty participants attended the training with an anticipated output of the first batch of the EPN product to be rolled out in their respective regions during the period.

Farmers training on coconut entrepreneurship

An interstate training on entrepreneurship development programme on coconut cultivation was conducted at ICAR - CPCRI, Kasaragod from 15th - 19th January, 2019. Five farmers from Gir Somnath district of Gujarath state attended in the training programme. The training programme was coordinated by Dr. Rajkumar and Dr. Vinayaka Hegde and the course director was Dr. K. Muralidharan.

Farmers from Gujarat along with the resource persons of the training programme at Kasaragod

Another training programme on 'Coconut production technology' was conducted for 46 farmers from Tumkur district organized by KVK, Tiptur, Tumkur on 23rd January, 2019.

One more training programme on ' Integrated crop management in coconut' was organized for 30 farmers from Tiptur, Karnataka during 28th-29th March, 2019.

On-campus programme

Six ATMA interstate training programmes on 'Neera and its value added products' were conducted benefitting 157 farmers of Erode, Puthukottai,Kanyakumari and Vellore districts of Tamil Nadu during the period at ICAR- CPCRI, Kasaragod.

ATMA, Kerala training programme for 30 farmers from Edayur, Kuttipuram block, Malappuram district was conducted on 14thJanuary, 2019 and for 43 farmers from Karimba, Mannarkad block, Palakkad during 24th and 25thJanuary, 2019 at ICAR- CPCRI, Kasaragod.

Workshop on 'Transition to organic farming in Kasaragod district -Status and strategies was conducted at ICAR-CPCRI, Kasaragod on 13th February, 2019 for 125 agricultural officials. The workshop was coordinated by Dr. C. Thamban and Dr. S. Jayasekhar.

A training programme was conducted on 15.02.2019 on arecanut based cropping system at Research Centre, Mohitnagar. A total of 20 farmers of Kalchini Block of Alipurduar district attended the training programme.

Arecanut palm climbing training

A training programme for the rural youth on arecanut palm climbing was organized at ICAR-CPCRI, RS, Vittal during 5th to 8th February, 2019. The programme was conducted in collaboration with the CAMPCO, Mangaluru, in which 30 youth have participated.

Farmer Field School (FFS) valediction and field visit

The concluding session of FFS programme conducted at Oachira (Kollam District) was conducted at ICAR-CPCRI, Kayamkulam on 04-01-2019. The farmers of FFS were taken around the experimental plots and were imparted upskilling and infused confidence in scientific farming practices including aquaculture in coconut garden.

A view of the training on arecanut palm climbing under progresss

Off-campus programmes

Coconut seminar at Kattapana

A seminar on coconut development in Idukki high ranges was organized by State Department of Agricultural Development and Farmer's Welfare on 28th January, 2019 at Kattapana in which a technical session on pest and disease management in coconut attended by more than 100 farmers.

Capacity building programme for agricultural officers

As part of the technology support project, capacity building programmes were organized on health management of palms for Agricultural Officers of Pathanamthitta, Alappuzha and Ernakulam districts on 11st January, 2019, 16th January, 2019 and 30th January, 2019, respectively.

Diagnostic field visit in Kozhikode district

The scientific team visited coconut gardens around Kozhikode on 21st February, 2019 and found the occurrence of Bondar's nesting whitefly, *Paraleyrodes bondari* at Mettilakaleri, Mannur at low level of infestation. Association of the scolytid beetle, *Xylebmorus perforans* on basal stem rot infected coconut palms could be noticed at Kanezhathu, Venapara. Root (wilt) disease was also observed at Kozhakadu, Atholi. Remedial measures were also suggested based on the diagnostic symptoms noticed.

Farmer's training programmes

Training programmes for farmers on knowledge empowerment and skill upgradation on scientific coconut farming was imparted at Poothakulam, Vazhapally and Cheriyanad panchayats on 1st February, 2019, 8th February, 2019 and 13th February, 2019, respectively.

Inauguration of farmers training programme and participants at Averse village, Udupi district of Karnataka

Diagnostic field visit showing root grub larvae to the participants

Training programme on arecanut palm health management with special emphasis on the 'Bio-suppression of root grub using entomopathogenic nematodes (EPN) and multispecies cropping system in arecanut' sponsored by the Directorate of Arecanut and Spices Development (DASD), Kozhikode was conducted in Averse village, Udupi district of Karnataka on 11th January, 2019. Eighty farmers participated in the training programme.

Off campus training programme on 'coconut cultivation practices for 42 farmers was conducted at Sullia on 14th February, 2019 which was organized by Assistant Director of Horticulture, Sullia.

Dr. Arun Kumar Sit, Principal Scientist delivered a lecture on "Propagation techniques of plantation crops and nursery management at KVK, Coochbehar on 15th February, 2019 as a part of "Skill Development Programme for Nurseryman". A total of 30 nurserymen were trained.

Field Demonstrations

Demonstration of 'hybridization techniques in arecanut' was organized for participants from University of Agricultural and Horticultural Sciences (UAHS), Shivamogga, Karnataka on 13th March, 2019 at ICAR-CPCRI, Regional Station, Vittal.

Exposure visit cum training programmes

Exposure visit cum training programme at CPCRI, Kasaragod were organised for 163 college students 183 farmers at ICAR-CPCRI, Kasaragod, 125 farmers at ICAR-CPCRI, Regional Station, Kayamkulam. Training cum exposure visits to ICAR-CPCRI, Regional Station, Vittal for 16 students and 313 farmers were also organised. A total of 40 college student and 76 farmers of West Bengal have visited CPCRI, Research Centre, Mohitnagar during this quarter.

Participation in Seminar/Exhibitions

SL. No.	NAME	DATE	Place
1	Deepika Karshika Mela 2019	4th-14th January, 2019	Thamarassery
2	Vyavasaya Mela	15th-20th January, 2019	Kanhangad
3	Thaliru – Malayora Karshika Maholsavam	16th-20th January, 2019	Malom
4	National Horticulture Fair	23rd-25th January, 2019	IIHR, Bangalore
5	Fresh Expo Fest 2019	23rd January - 3rd February, 2019	Taliparamba
6	Udyam Samaagam	24th-25th January, 2019	Lulu convention centre, MSME, Thrissur
7	Kerala State Biodiversity Board - Exhibition	26th-28th January, 2019	Thalassery
8	Agri Summit 2019	10th-12th February, 2019	Gandhi Maidan, Motihari, Bihar
9	Exhibition	15th-16th February, 2019	CMFRI, Kochi
10	ASC India Expo	20th-23rd February, 2019	NAAS, New Delhi
11	Exhibition	20th February - 10th March, 2019	Palakkunnu Bhagavathi Temple, Kasaragod
12	Krishi Yantra Mela & Dream Home	23th to 25th February, 2019	Vivekananda College of Engineering and Technology, Puttur
13	Seminar-Foreign trade-rules and regulations	27th February, 2019	City tower hotel, Kasaragod
14	Exhibition	20th February – 10th March, 2019	Palakunnu Kasaragod
15	Coastal Agri Expo	2nd to 4th March, 2019	Old Goa
16	PLACROSYM XXIII-Scientific Exhibition	6th-8th March, 2019	CCRI, Chikmangaluru
17	Krishi Mela at KVK, Jalpaiguri district	18th-20th February, 2019	Sadar Block of Jalpaiguri
18	Mati Utsab	22nd-24th February, 2019	Sadar Block of Jalpaiguri

Further, outreach from Regional Station Kayamkulam, 1398 participants spread across 28 transfer of technology activities held at different locations of southern districts from Ernakulum to Thiruvananthapuram districts of Kerala.

Mera Gaon - Mera Gaurav

A farmer-participatory decentralized coconut seedling production programme was initiated at Vallikunna, Chunakara and Bharanikavau panchayat as part of MGMG activity. Healthy mother palms (*Amma thengu*) were identified and nut collection initiated. School students in Chingoli were motivated for scientific vegetable production within the school premises.

Two exhibitions were organized on 'Multi Species Cropping System in Arecanut' and Training on 'Integrated Pests and Diseases Management in Arecanut' funded by Directorate of Arecanut and Spices Development (DASD), Calicut on 22nd January, 2019 at Kuppepadavu, Mangaluru Taluk, and on 2nd March, 2019 at Mr. Pidamale Govinda Prasad's garden, Kodungai, Bantwal Taluk, Dakshina Kannada Dt. Karnataka. A quiz competition was also organized for the participants.

Scientists-Farmers' interface at Kodungai, Bantwal taluk, D.K., Karnataka

Scientists-Farmers' interface at Kuppepadavu, Mangaluru taluk, D.K., Karnataka

Inputs like *Trichoderma* and Neem cake are supplied to beneficiary farmers of Directorate of Arecanut and Spices Development (DASD), Calicut funded demonstration plots on arecanut based multi species cropping systems at eight Mera Gaon Mera Gaurav villages.

Copper sulphate and lime were also provided to beneficiary farmers of demonstration plots for plant protection measures.

Supply of *Trichoderma*, neem cake, copper sulphate and lime to beneficiary farmers of demonstration plots at MGMG villages

Krishi Vigyan Kendra, Kasaragod

On Farm Trials

KVK implemented on farm trials in eight farmers' fields on management of rhinoceros beetles (Mangalpadi and West Eleri) and Performance evaluation of dwarf coconut varieties (Mangalpadi and West Eleri) during the reported period.

Frontline Demonstrations (FLD)

Eleven frontline demonstrations were carried out during the reported period. Demonstrations on HYV of paddy Shreyas (Chemnadu) High Yielding Variety of fodder, Sampoorna (Paivalike and Kuttikkol), Marigold variety, Pusa Narangi (Ajanur), HYV and disease tolerant variety of pepper, Thevam (Ballal and Pullur Periye) and Management of yellowing and wilting in pepper (Kunjar), demonstration of micronutrient spray in banana (Puthige), demonstration of grafted vegetables (Vidyanagar) mechanization in rice (Kolavayal) and demonstration of water recharging systems in open wells and tube wells (Kasaragod), Introduction of PPFM for drought management in paddy (Manjeshwar) and management of Ganoderma wilt in coconut (Velutholi) was carried out during the reported period.

Demonstration of pulses cultivation under NFSM: Demonstrations on green gram was carried out in 50 acres of land at Ajanur, Pallikkare and Pullur – Periye panchayaths. The demonstration was highly successful with a yield of 11.2 quintals per hectare obtained from Kolavayal village of Ajanur panchayat.

Training

KVK, Kasaragod organized 19 training programmes for the benefit of 280 participants (83 men and 197 women) comprising of farmers, farm women, rural youth and members of self-help groups during the period from 11 January 2019 to 31 march 2019. The details are as follows.

Programme duration	No. of trainings	Participants		
		Men	Women	Total
1 day	5	30	41	71
2 days	10	11	141	152
5 days	1	0	11	11
21 days	1	4	2	6
25 days	2	38	2	40
Total	19	83	197	280

Skill development training programmes:

Two skill development training programmes of one month duration were conducted in the trades of coconut grower and Friends of Coconut Tree with ASCI. A total of 40 participants attended the programme.

FET progaramme: A field experience training programme was organized for six scientist probationers of NAARM from 19th February, 2019 to 11th March, 2019.

Kudumbasree Training: Organised a paid training programme for 100 Kudumbashree members.

PM -KISAN Sammelan: Organised a farmers meet and seminar in connection with the national level launching of the scheme PM-KISAN by Hon'ble Prime minister of India on 24th February, 2019. Around 200 farmers and officials participated in the event. The event was inaugurated by Shri N.A. Nellikkunnu, Hon'ble MLA, Kasaragod and was attended by Dr. Sajith Babu IAS, Hon'ble district collector.

Resource material / Demonstration

Machinery for custom hiring centre: The machinery required for doing various agricultural operations were procured for establishment of a custom hiring centre in KVK. The machinery procured include tractor, rotavator, disc plough, reversible MB plough, cultivator, small tractor, trolley, cultivator, land leveller, power tiller, bund former,

Skill development training programme at KVK, Kasaragod


Value addition training programme at KVK, Kasaragod

transplanter, power weeder, back pack power weeder, mulcher cum drip laying machine, brush cutter and zero till drill.

Precision Farming Unit: A precision farming demonstration unit was established in KVK with drip system with fertigation, sprinkler and micro sprinkler units for demonstration of open field precision farming to farmers.


Launching of the scheme PM-KISAN programme

Krishi Vigyan Kendra, Alappuzha

KVK-ATMA Technology meet and Farmer-Scientist interface

District level technology meet was organized in collaboration with ATMA and Department of Agriculture, at Mavelikkara Town Hall on 31st January and 1st February, 2019. The programme was inaugurated by Hon. MP Sri. Kodikunnil Suresh. Seminar on 'Eco-friendly pest management practices' and Farmer-Scientist interface on 'Doubling farmers income' were conducted by the KVK. More than 400 farmers attended the two days programme. An Agricultural Exhibition with 25 stalls was arranged with the participation of Agriculture and allied departments, other agencies, and SHGs of the district. About 900 persons including students visited the exhibitions.

Harvest festival and field days

Field day of the FLD on "Rhizome rot management in ginger using PGPR GRB 35 capsules" was conducted at Thamarakulam on 24th January, 2019. Thirty five ginger farmers participated in the programme. Another field day of the FLD on "Mosaic resistant cowpea variety Geethika" was conducted at Thamarakulam on 28th January, 2019. Twenty nine vegetable farmers participated in the programme.

Webcasting of the inauguration of PM-KISAN

Inauguration of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) – 2019 by Hon. Prime Minister Shri Narendra Modi at Gorakhpur, Utter Pradesh on 24th February, 2019 was live webcasted to about 50 farmers.

Scientific Advisory Committee (SAC) meeting: Seventeenth SAC Meeting of the KVK was conducted on 15th February, 2019. The meeting was presided over by Dr. (Mrs.) Anitha Karun, Acting Director, ICAR-CPCRI, Kasaragod. Twenty two members of the SAC and all staff members of the KVK participated in the meeting.

Trainings/ Meetings conducted:

Training programmes

During the period organized 15 training programmes benefitting a total number of 422 farmers/rural youths. The details of the training programmes were as follows:

Training	No. of Programmes	Participants		
		Men	Women	Total
On campus	4	57	56	113
Off campus	5	77	71	148
Sponsored	6	62	99	161
Total	**15**	**196**	**226**	**422**

Helpline service (calls attended and responded) – 712 nos; Agroclinic – 146; Soil testing campaign – 6 nos; Animal Health camp –2; Exhibition –1; Seminar – 5 no.

PARTICIPATION IN NATIONAL SEMINARS/SYMPOSIA/CONFERENCES/WORKSHOPS

Name & designation	Title	Place and date
Dr. V. Krishnakumar, Head, RS, Kayamkulam Dr. A. Joseph Rajkumar, Pr. Scientist	Workshop on Development of Coconut Sector	Gandhiji Study Centre, Thodupuzha 1st January, 2019
Dr. L.S. Singh, Scientist	8th Indian Horticulture Congress, Shaping Future of Indian Horticulture	Indira Gandhi Krishi Viswavidyalaya, Raipur, Chhattisgarh, 17th to 21st January, 2019
Dr. (Mrs) Alpana Das, Sr. Scientist	State Level Workshop on Coconut	Shilpagram Auditorium Hall, Panjabari, Guwahati on 2nd February, 2019
Dr. K. B. Hebbar, Acting Head, PB&PHT, Dr. Murali Gopal, Principal Scientist and Dr. Krishna Prakash, Scientist	XIV Agricultural Science Congress and ASC India Expo-2019	NASC, Pusa, New Delhi 20-23 February 2019
Dr. Anitha Karun, Acting Director, Dr. Vinayaka Hegde, Dr. K.B. Hebbar, Heads of Div., Dr. V. Krishnakumar, Head, RS, Kayamkulam, Dr. M.K. Rajesh, Dr. A.C. Mathew, Dr. Murali Gopal, Dr. Alka Gupta, Dr. Chandran K.P., Dr. P. Subramanian, Pr. Scientists, Dr. S. Jayasekhar and Dr. Senthil Amudhan, Sr. Scientist, Dr. K. Nihad, Dr. Jeena Mathew, Dr. S. Indhuja, Dr. N.R. Nagaraja and Ganesh N. Khadke, Dr. M. Neema, Dr. S.V. Ramesh, Dr. Rajkumar, Dr. Krishna Prakash, Dr. R. Sudha, Scientists and Dr. K.S. Muralikrishna, Tech. Assistant	23rd Plantation Crops Symposium	Chikkamagaluru, Coffee Board 6th to 8th March, 2019
Dr. Anitha Karun, Acting Director, Dr. Vinayaka Hegde, Head of Div. of Crop Protection, Dr. P. Subramanian, Dr. C. Thamban, Dr. A. Joseph Rajkumar, Principal Scientist, Dr. Jeena Mathew, Scientist	National Workshop on 'Plant Health Management of Coconut: Challenges and Future Opportunities'	NIPHM, Hyderabad 14-15th March, 2019
Dr. P. Muralidharan, Pr. Scientist and Head and Rajeev M.S., and Dr. S. Ravi, SMSs	Workshop on "Eco – friendly Kuttanad"	RRS, Moncompu 1st March, 2019

New Projects

Technology backstopping to Agro-clinics of the Dept. of Agriculture (Crop Health Management Scheme) was sanctioned to provide technological backstopping in pest surveillance and crop health management activities of the Dept. of Agriculture, Govt. of Kerala with an outlay of ₹ 6.25 lakhs during 2018-19.

The project titled 'Entrepreneurship development through farmer led innovations – Study in plantation crops' was sanctioned under NASF-ICAR. The total cost of the project is Rs 79.54 lakhs and the fund allotted for the collaborating centre (ICAR-CPCRI) for three years is Rs. 21.9 lakhs. Collaborating Centre PI: is Dr. T.S. Manojkumar, Head, KVK, Kasaragod and Collaborating scientists (Co-PIs) are Dr. Jayasekhar S, Sr. Scientist ICAR-CPCRI, Kasaragod and Sandip Shil, Scientist, ICAR-CPCRI, Research Centre, Mohitnagar.

Celebration

Republic Day

Republic Day was observed in the headquarters, Regional Stations and Research Centres on 26th January 2019. Dr. Anitha Karun, Acting Director, delivered Republic Day speech at Kasaragod.

Dr. Anitha Karun, Acting Director, ICAR-CPCRI, Kasaragod delivering Republic Day speech

National Productivity Week

The National Productivity Week was observed at the Institute during 12th-17th February, 2019, which was inaugurated at ICAR-CPCRI, Kasaragod by Dr. Hari Kurup K.K., Head, Dept. Economics, Govt. College, Kasaragod on 13th February, 2019. The programme was chaired by Dr. Anitha Karun, Acting Director, ICAR-CPCRI, who stressed the need for maintaining punctuality and dedication and thereby enhancing the work output. Dr. Hari Kurup delivered a lecture on 'Circular Economy for Productivity and Sustainability'. He explained how the topic is relevant in the Indian context, especially in the agricultural sector where the aspects of productivity, sustainability and circularity (cycles) play crucial roles. He has alluded the possibilities of a paradigm shift wherein the routine aspects of life might be replaced in the near future with machines, artificial intelligence and robotics.

Inaugural speech by Dr. Hari Kurup on 'Philosophy of Circular Economy'

International Women's Day

At ICAR – CPCRI, Kasaragod International Women's day was celebrated on 8th March, 2019 in a befitting manner. The celebration commenced with the Hon'ble Prime Minister's address on the occasion, which has been telecasted through live streaming for the benefit of ICAR - CPCRI employees. Dr. Neetha Joseph, Lecturer (Psychology), Teachers Training Centre, Vidyanagar was the chief guest of the function. She addressed the gathering on the psychological aspects of balancing the women in personal and professional life. Dr. Anitha Karun, Acting Director, presided over the function, she has emphasized the importance of the theme of this year, and on the role of women's education for nation building.

During the International Womens' Day, a lecture was arranged at ICAR-CPCRI, Regional Station, Kayamkulam on 8th March, 2019, in which Dr. M. N. Girija, Gynaecologist, Parabhrama Hospital, Oachira, was the chief guest. She delivered a talk on the topic "Women and health care" for the benefit of staff and family members.

Distinguished Visitors

Shri P.J. Joseph, MLA, Govt. of Kerala visited ICAR-CPCRI, Kasaragod on 24th January, 2019

Other Information

Swachh Bharat activities conducted at Regional Station, Kayamkulam

The staff members of ICAR-CPCRI, Kayamkulam actively participated in the sanitation and cleaning drive as part of Swachh Bharat Campaign on 19th January, 27th February and 27th March, 2019. The items of activity identified were weeding out of old files and other unwanted materials in and around the campus, stock taking of old furniture which can

be repaired and re-used, cleaning of work spaces including lab and office premises. All the equipment and furniture were organized and rearranged in the respective places. Wastes accumulated in and around the campus were collected and discarded.

Trade Marks received

Bio-product	Trade Mark No.	Date received	Published in
KerAM	2813918	3rd Dec., 2018 w.e.f. 01.08.2014	Trade Marks Registry Government of India
Kera Probio	2813921	3rdDec., 2018 w.e.f. 01.06.2014	-do-

Personalia

APPOINTMENTS

Name	Designation	Place	Date
Shri Kamal Kumar V.	Tech. Assistant (F/F)	CPCRI RC, Kidu	05.01.2019
Shri Anoop Kumar P.P.	Tech. Assistant (F/F)	CPCRI RC, Kidu	05.01.2019
Shri Fawaz C.M.O.	LDC	CPCRI RS, Vittal	13.02.2019

PROMOTIONS

Name of the staff	From (Designation)	To (Designation)	w.e.f.
Smt. Rupa Manikandan	UDC	Assistant	08.01.2019
Shri Udaya Kumar	LDC	UDC	11.01.2019
Smt. Mary A.J.	LDC	UDC	11.01.2019
Smt. Remya T.R.	LDC	UDC	11.01.2019
Shri Mohammed Haneefa P.K.	LDC	UDC	11.01.2019

RETIREMENT

Name	Designation	Place	Date
Dr. P. Chowdappa	Director	CPCRI, Kasaragod	10.01.2019 on voluntary retirement
Smt. Annamma N. Topino	Assistant	CPCRI RS, Kayamkulam	31.01.2019
Shri M.V. Madhavan	Sr. Tech. Asst.	CPCRI, Kasaragod	10.03.2019
Shri K. Vijayan	Coupon Clerk	CPCRI, Kasaragod	31.03.2019

Agrisearch with a human touch

KALPA

Front cover photo: Shri E. Chandrasekharan, Hon'ble Minister for Revenue and Housing, Govt. of Kerala, Shri Rajasekharan, Hon'ble MLA , Thrikkarippur along with Dr. Anitha Karun, Acting Director, ICAR-CPCRI, Kasaragod visiting Agri Exhibitions as a part of Punarnava Kisan Mela - 2019 at ICAR-CPCRI, Kasaragod.

Published by: Dr. Anitha Karun, Acting Director
Compiled and edited by: Dr. S. Jayasekhar, Shri H. Muralikrishna and Dr. Anitha Karun
Photo credits: Shri K. Shyama Prasad and Shri E.R. Asokan
ICAR-Central Plantation Crops Research Institute, Kudlu P.O., Kasaragod, Kerala - 671 124
Phone: 04994 232893, 232894, 232895, 233090, 232333 (Director); Fax: 04994 232322
E-mail: directorcpcri@gmail.com, cpcrinews@gmail.com
Website: www.cpcri.gov.in; Facebook: cpcrikasaragod.kerala
Printed at: Print Express, Kaloor, Kochi – 682017, Ph: 0484-2531336