PLACROSYM XXI
Kozhikode 2014

Proceedings and Recommendations of International Symposium on Plantation Crops (PLACROSYM XXI)

10-12 December 2014, Kozhikode, Kerala, India
Converging technologies for sustainability

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Citation

Dinesh R, Santhosh J Eapen, Senthil Kumar CM, Devasahayam S, John Zachariah T & Anandaraj M (Eds) Proceedings-International Symposium on Plantation Crops (PLACROSYM XXI), ICAR-Indian Institute of Spices Research, Kozhikode, Kerala, India.

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Published by

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Printed at GK Printers, Kochi

FOREWORD

Plantation crops in India are considered to be the main segment of horticulture crops. They are the mainstay of agrarian economies in many states and union territories of the country and play an important role in the agricultural and industrial development as a whole and contribute a significant amount to the national exchequer and country's exports by way of excise and export earnings. They also provide direct and indirect employment to large number of people, and thus try to supplement the poverty alleviation programmes, especially in rural sector. The major plantation crops include coconut, arecanut, oil palm, cashew, tea, coffee and rubber and the minor plantation crops include cocoa and spices. The Government of India has identified some prominent crops as high-value crops of great economic importance and is taking all possible steps and initiatives to commercialize the sector. However, the plantation crops have been continuously facing the problem of lack of investment and lower productivity. Their total coverage is comparatively less and they are mostly confined to small holdings.

A unique initiative of research and development institutions associated with plantation crops in India is the organization of Symposia on Plantation Crops (PLACROSYM) biennially. The main objective of the symposia is to provide a common forum for interaction among scientists, industry, and extension and development agencies engaged in plantation crops research and development. The present symposium which is 21st in the series was proposed as an international one with the theme 'Converging technologies for sustainability'.

I congratulate the entire organizing team for the successful conduct of this international event and also commend them for bringing out the proceedings of the each session of the symposium. I sincerely hope that this publication would provide valuable information on research and development in the plantation sector and wish that this will stimulate further exploration of various facets which would help us move towards overwhelming growth and development of the plantation sector worldwide.

(M Anandaraj)
General Chairman

INTERNATIONAL SYMPOSIUM ON PLANTATION CROPS (PLACROSYM XXI)

The Gateway Hotel, Kozhikode, Kerala, India
10-12 December 2014

Hosted by

- ICAR-Indian Institute of Spices Research, Kozhikode, Kerala
- Indian Council of Agricultural Research, New Delhi

Organized by

- Central Coffee Research Institute, Balehonnur, Karnataka
- Coconut Development Board, Kochi, Kerala
- ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala
- ICAR-Directorate of Cashew Research, Puttur, Karnataka
- ICAR-Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh
- Indian Cardamom Research Institute, Kochi, Kerala
- Rubber Research Institute of India, Kottayam, Kerala
- Tea Research Association, Tocklai Experimental Station, Jorhat, Assam
- UPASI Tea Research Foundation, Valparai, Tamil Nadu
- Indian Society for Plantation Crops, Kasaragod, Kerala
- Indian Society for Spices, Kozhikode, Kerala
- Society for Promotion of Oil Palm Research and Development, Pedavegi, Andhra Pradesh

Co-sponsored by

- Indian Council of Agricultural Research, New Delhi
- State Horticulture Mission, Thiruvananthapuram, Kerala
- Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala
- National Bank for Agriculture and Rural Development, Thiruvananthapuram, Kerala
- Spices Board, Kochi, Kerala
- Directorate of Cashew nut and Cocoa Development, Kochi, Kerala
- Tea Board, Kolkata, West Bengal
- State Bank of India, Kozhikode, Kerala
- Harrisons Malayalam Limited, Kochi, Kerala

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HISTORY OF PLACROSYM

The First National Symposium on Plantation Crops was held in 1972 at Trivandrum, Kerala. However, it cannot be considered as a part of PLACROSYM series. Subsequently, the title National Symposium on Plantation Crops was modified as Annual Symposium on Plantation Crops in 1978, making it an annual event till PLACROSYM V. The symposium later (from PLACROSYM VI) became a biennial event and is being hosted by different research institutes engaged in research and development of plantation crops in India.

The objective of the symposium is to provide a common forum for interaction among the scientists, industry, entrepreneurs, extension and development agencies engaged in plantation crops research and development. The symposium also provides a platform for exchanging scientific ideas and technologies developed in various member institutions and to put in a collective thought for the overall development of the plantation sector. Further, it offers opportunity for young scientists to acquire scientific knowledge through inspiring lectures by experts and participating in thought provoking discussions.

To date, 21 PLACROSYMs have been held in different regions of India:

- PLACROSYM I (20–23 March 1978, Kottayam, Kerala)
- PLACROSYM II (26–29 June 1979, Udhagamandalam, Tamil Nadu)
- PLACROSYM III (12–15 December 1980, Kochi, Kerala)
- PLACROSYM IV (3–5 December 1981, Mysuru, Karnataka)
- PLACROSYM V (15–18 December 1982, Kasaragod, Kerala)
- PLACROSYM VI (16–20 December 1984, Kottayam, Kerala)
- PLACROSYM VII (16–19 October 1986, Coonoor, Tamil Nadu)
- PLACROSYM VIII (28–30 December 1988, Kochi, Kerala)
- PLACROSYM IX (5–7 December 1990, Bengaluru, Karnataka)
- PLACROSYM X (2–4 December 1992, Kasaragod, Kerala)
- PLACROSYM XI (30 November–3 December 1994, Kozhikode, Kerala)
- PLACROSYM XII (27–29 November 1996, Kottayam, Kerala)
- PLACROSYM XIII (16–18 December 1998, Coimbatore, Tamil Nadu)
- PLACROSYM XIV (12–15 December 2000, Hyderabad, Andhra Pradesh)
- PLACROSYM XV (10–13 December 2002, Mysuru, Karnataka)
- PLACROSYM XVI (14–17 December 2004, Kasaragod, Kerala)
- PLACROSYM XVII (5–8 December 2006, Kochi, Kerala)
- PLACROSYM XVIII (10–13 December 2008, Puttur, Karnataka)
- PLACROSYM XIX (7–10 December 2010, Kottayam, Kerala)
- PLACROSYM XX (12–15 December 2012, Coimbatore, Tamil Nadu)
- PLACROSYM XXI (10-12 December 2014, Kozhikode, Kerala)



About PLACROSYM XXI

PLACROSYM XXI which is the 21st in the series of plantation crops symposia was proposed as an international one with the theme 'Converging technologies for sustainability' to provide a platform to address and discuss recent developments in the production, utilization and marketing of plantation crops in the context of global challenges confronting this sector. The symposium was held during 10-12 December 2014 at 'The Gateway Hotel' Kozhikode, Kerala, India. The symposium consisted of five sessions and each technical session had lead papers (invited) and contributory papers (oral and poster). In addition, special sessions on Farmer-Entrepreneur-Researcher Interface and a Panel Discussion on Research and Development on Plantation Crops-The Way Forward were also held. The following were the technical sessions:

Session I	: Varietal wealth (Germplasm, Genetics, Breeding)
Session II	: Production systems (Agronomy, Soil Science, Physiology, Biochemistry)
Session III	: Plant health management (Pathology, Entomology, Nematology)
Session IV	: Value chain management (Post-harvest Technology, Economics)
Session V	: Knowledge management (Extension)

Eleven lead papers, 30 oral papers and 263 poster papers were presented in the six sessions during the symposium. Awards were also presented to the best oral and poster presentations in various sessions. The symposium was attended by 375 delegates. An exhibition showcasing the technologies developed by various institutions and commercial organizations related to agriculture was also arranged.



About the logo

PLACROSYM XXI
Kozhikode 2014

The PLACROSYM XXI logo symbolises the multitude of technologies available in the plantation crops sector. The icons used in the logo have been chosen to reflect the increased role of electronics, bioinformatics and IT in agriculture. The icons with leaves/ fruits represent various crops coming under the ambit of PLACROSYM. All the icons are in green colour and converge on a base line parallel with the title of the symposium indicating stability, sustainability as well as the prominent role of PLACROSYMs in the development of this sector.



INAUGURAL SESSION
(10 December 2014)

The inaugural session started at 9.30 am with an invocation followed by welcome address by Dr. M. Anandaraj (General Chairman, PLACROSYM XXI). He welcomed all the dignitaries and delegates including Prof. M.S. Swaminathan (Emeritus Chairman, M. S. Swaminathan Research Foundation, Chennai); Dr. P. Rajendran (Vice-Chancellor, Kerala Agricultural University, Thrissur); Dr. N. K. Krishna Kumar (Deputy Director General (Horticultural Science, ICAR, New Delhi) and Dr. S. Devasahayam (General Convener, PLACROSYM XXI). He described the aim and scope of PLACROSYMs and the background for hosting the symposium at Kozhikode.

The symposium was inaugurated by Prof. M. S. Swaminathan by lighting the lamp. In his inaugural address, Prof. Swaminathan emphasized the importance of plantation crops in the socio-economic development of India. He also drew the attention to the challenges in the cultivation of plantation crops, like under investment, low capital and yield levels. He referred to the UN decisions on sustainable development through better soil and water management. Prof. Swaminathan also emphasized the importance of nutraceuticals and value addition in spices and other plantation crops, promotion of inter cropping medicinal and aromatic plants in plantations, farmer to farmer technology transfer through farm schools. He also stressed on the development and deployment of biotic and abiotic stress tolerant low input responsive varieties and precision farming; judicious utilization of water resources and optimal use of state of art IT and nano technologies in plantation sector.

Five publications were released during the inaugural session. The Abstract of Papers and Souvenir were released by Prof. M. S. Swaminathan and special issues of Indian Horticulture, Spice India and Journal of Arecanut, Spices and Medicinal Plants by Dr. N. K. Krishna Kumar. A book on 'Phytophthora Diseases of Plantation Crops' was released by Dr. P. Rajendran. A lichen garden of Malabar Botanical Gardens, Kozhikode was inaugurated by Prof. M. S. Swaminathan by ceremoniously handing over a plant.

Dr. P. Rajendran in his presidential address mentioned that the main issues confronting the plantation crop sector were replanting old plantations, non-availability of processing facilities, price volatility and labour shortage. He emphasized the need for mechanization suitable for Kerala terrain, development of suitable varieties, efficient pest and disease management strategies, support for new methods of irrigation and crop insurance.



In his keynote address, Dr. N. K. Krishna Kumar, emphasized that the research on plantation crops should focus on developing ecologically sustainable technologies including use of biocontrol agents for management of pests and diseases.

The keynote address was followed by presentation of different awards instituted by the Indian Society of Plantation Crops. The following awards were presented:

Dr. C. S. Venkataraman Memorial Trust Award for Distinguished Plantation Crops Scientist: Dr. M. Anandaraj and Dr. K. Nirmal Babu (Presented by Prof. M. S. Swaminathan).

Best Research Paper Award of JPC: Dr. Molly Thomas et al. (Presented by Dr. P. Rajendran).

Supari Federation Award for Best Scientist: Dr. Anita Karun and Dr. Gobinda Acharya (Presented by Dr. N. K. Krishna Kumar)

Supari Federation Award for Best Arecanut Farmer: Mr. B. A. Narayana (Presented by Prof. M. S. Swaminthan).

Mehta Foundation Award for Best Innovative Farmer: Mr. J. N. Jagath Bhusan (Presented by Prof. M. S. Swaminathan).

PLACROSYM Logo Award: Dr. S. J. Eapen (Presented by Dr. M. Anandaraj)

Subsequently, an exhibition showcasing technologies developed by various institutes and agencies was inaugurated by Prof. M.S. Swaminathan.

Dr. S. Devasahayam, proposed vote of thanks to the dignitaries and all other participants. The inaugural session ended at 11.10 am with National Anthem.

The rapporteurs of the inaugural session were Dr. R. Ramakrishanan Nair, Principal Scientist, ICAR-Indian Institute of Spices Research, Kozhikode and Dr. E. Jayashree, Senior Scientist, ICAR-Indian Institute of Spices Research, Kozhikode.



INAUGURAL ADDRESS

Plantation crops – Challenges Ahead in an Era of Climate Change

Prof M. S Swaminathan FNA, FRS

Founder Chairman and Chief Mentor, MS Swaminathan Research Foundation Chennai, Tamil Nadu, India

Plantation crops have a key role in the socio-economic development and transition from a subsistence agrarian economy to market oriented commercial cultivation due to their trade significance. Cultivation of plantation crops in India also has a rich diversity and varied history with each crop having its own distinct historical and economic context of development.

This sector has evolved as a significant driving force of growth and development of the agrarian economy of many states in India. The sector also contributes a significant amount to the foreign exchange earnings through export. The major plantation crops in the country include coconut, arecanut, oil palm, cashew, tea, coffee and rubber. Apart from this, several spice crops and cocoa can also be considered as plantation crops. The plantation crop sector is well integrated with many other sectors of the economy through vertical and horizontal linkages. The magnitude of direct and indirect employment provided by the sector, especially in the rural areas, makes it a vital cog in policy perspectives for overall economic development of the nation.

The rising population and the increase in purchasing power means that the demand for the major agricultural produce from the plantation crops sector will continue its robust growth. The area and productivity of the major plantation crops has also witnessed significant positive trend during the last five decades. The weight assigned in calculation of whole sale price index (WPI) to the products directly linked to the plantation crop sector has increased by 12.1 per cent for base year 2004-05 indicating the growing importance of products from plantation crops in our daily life.

Role of plantation crops in economic development

The economy associated with the major plantation crop has significant forward and backward linkages to a large number of other sectors. The vertical linkages by way of value addi-



tion and post-harvest processing for each crop increases the significance of the plantation crop sector, both in terms of employment generation and livelihood security. Most of the plantation crops in India are cultivated by small holder producers. For example 93 per cent of the total rubber production in the country is done by nearly 1.3 million of small farm holdings with an average holding size of 0.54 ha. Holdings less than 2 hectares constitute 81 per cent of the total number of holdings in coffee.

The direct and indirect employment generation potential of the sector is well documented. The tea industry is India's second-largest employer with over 3.5 million workers employed across the tea-growing estates. The average number of persons employed daily in coffee plantations is estimated to be 0.62 million during 2012-13. In case of rubber plantations the average daily employment increased from 0.16 million in 1976 to 0.46 million in 2010-11. Similarly, other plantation crops also provide productive employment to the significant number of workers. The indirect employment provided through the respective industries and its associated firms will be more than the direct employment as these crops require extensive post-harvest processing and value addition.

Apart from meeting the demands of a huge domestic market, the exports originating from plantation crop sector earns considerable foreign exchange. India is one of the major exporters of cashew and coffee in the international market. The cashew sector exports alone brought in 832 million USD whereas, the value of coffee exported was 793 million USD during 2013-14. The 225 million kilogram of tea exported during 2013-14 was valued at 747 million USD during the same period. Considering the direct exports from the plantation crop sector and the indirect exports from the associated sectors like the coir industry, rubber products industry etc., it can be seen that the sector offers huge potential for maintaining a favourable trade balance.

Trends of major crops in plantation sector

The area and production of plantation crops have shown a steady increase over the last few decades. Presently, the cumulative area under six major plantation crops (coconut, arecanut, cashew, tea, coffee and rubber) adds to 5.12 million hectares. Apart from this, crops like oil palm, cocoa, cardamom, pepper, nutmeg etc. cover an area of 0.60 million hectares..

The increase in productivity was driven by availability of improved technologies developed mainly in the public sector research and development institutions. The varietal technology, better plant protection technologies, concerted efforts for technology dissemination and institutional support for crop production has all played a vital role in enhancing the productivity. The increase in yield level was as high as 176 per cent for rubber, the highest in the world, between the period 1970-71 and 2010-11. The present level of area production and productivity of major plantation crops are in Table 3 along with India's share in global production for each of the crop.



Tea & Coffee

One of the major components of world beverage market, tea industry is one of the oldest organized agro-industry in India. India stands second in terms of global tea production with a share of 24.9 per cent, next to China. We have 12 per cent share of world tea exports and is also one of the largest consumers of tea in the world. During the XI plan (2007-2012), tea export grew at a rate of nearly 10 per cent per annum and the per capita availability has increased from 296 grams in 1960-61 to 728 grams in 2011-12.

India is the seventh largest coffee producer and the third largest in Asia. But in terms of production, the share of Arabica coffee, which was more than 50 per cent till 1980's, has declined to 31 per cent during 2012-13. The state of Karnataka accounts for 55.6 per cent of area and 70 per cent production of coffee in the country. India's share in world coffee production and exports are less than 5 per cent. The major share of Indian coffee exports is headed for European countries. During the period 2007-08 to 2011-12, the revenues from coffee exports grew at growth rate of 13.8 per cent per annum. Caffeine free coffee is gaining increased demand.

Arecanut

India is the world's leading producer of arecanut with a share of nearly 50 per cent of the total production; but the productivity is well below that of China (2745 kg/ha). The arecanut economy is driven by strong domestic demand which is estimated to be more than 0.33 million tonnes per year. The growing apprehensions about the potential health hazards of gutkha consumption, the alternative uses of the crop need to be developed and strengthened. Arecanut has numerous alternative uses in diverse applications like preparation of medicines, confectionery, food colouring, cloth dyeing, leather industry etc. I understand Ministry of Health is discouraging the use of Arecanut for health reasons.

Coconut

India is one of the major producers of Coconut in the word with a share of 16.4 per cent in 2012-13. Along with Indonesia and Philippines, it constitutes more than 75 per cent of the global coconut production. India has the highest productivity in coconut with a productivity level of 10,600 nuts/ha whereas, the average global productivity stands at 5833 nuts/ha. Though India is a major producer of coconut, the entire production is consumed in the domestic markets. Edible oil from coconut constitutes 14.4 per cent of the secondary source of edible oil in the country. The coir industry, a major small scale industry in the country is inherently dependent on coconut plantations for the raw material. Even though Kerala has the maximum area under the crop, Tamil Nadu is the major producer due to the high level of productivity in the state. The productivity in Kerala and Tamil Nadu were 8109 nuts/ha and 16387 nuts/ha



respectively during the year 2012-13. The economic returns from coconut plantations need to be augmented through coconut based mixed cropping and judicious practice of intercropping in view of higher magnitude of price fluctuation of the commodity in the international market. New products like virgin coconut oil and health drinks like 'neera' and bottled tender coconut water has great market potential and increases the income.

Cashew

India is one of the leading producers, processor and exporter of cashew in the world. India stands third in the production of raw cashew nut in the world behind Vietnam and Nigeria. India is also the leading exporter with a share of 65 per cent of the global exports for its superior product quality. The country exported 1.3 lakh tones of cashew kernals during the year 2012-13. Cashew is cultivated in nearly 1 million hectares of land with a productivity of 760 kilograms per hectare. The growth rate in export of cashew kernels from India has decelerated in the recent times whereas the imports of raw cashew have remained robust. The rising domestic demand for cashew kernels seems to be behind this trend.

Rubber

India holds a place of pride among the natural rubber producing countries in the world. The productivity of rubber in India is the highest in the world and the country is the third largest consumer of natural rubber. It is estimated that the annual turnover from the rubber industry surpasses 500 billion rupees. The entire domestic production is consumed by the well developed rubber based industries dominated by the auto tyre and tube industry. The production is not sufficient to meet the demand and the country remains a net importer of natural rubber accounting for nearly 10 per cent of global consumption. Small holder producers dominate the rubber production economy with more than 90 per cent of the area under the crop being operated by small holders. The import of natural rubber has shown a steady increase from 0.72 lakh tonnes in 2004-05 to 3.25 lakh tonnes in 2013-14.

Oil Palm

Oil Palm cultivation has assumed added significance in the recent past due to its potential for augmenting the indigenous availability of edible oil. The Commission for Agricultural Cost and Prices (CACP) has pointed out the need to promote the cultivation of oil palm in India in view of the steeply rising edible oil import bill. The potential area that can be brought under the crop is estimated to be 1 million hectares to produce about 4 million tonnes of palm oil. Presently an area of 0.23 million hectares of land has been brought under oil palm cultivation, largely due to the efforts undertaken through the Oil Palm Development Programme (OPDP). Andhra Pradesh accounts for about 60 per cent of the area under oil palm in India. Oil palm with its high yield of oil/ha has great potential in meeting the growing demand for edible oil.



Cocoa

The production of cocoa at the global level has witnessed a significant growth riding on the sustained increase in demand for chocolate across major developed and developing economies. India's share in global cocoa production is negligible, but the crop has immense potential to develop as a major commercial crop, especially in the southern parts of the country. The rising domestic demand for chocolate confectionery should also drive the expansion in area and production of the crop. The present level of domestic production is barely sufficient to meet 30-40 per cent of the domestic demand. India has emerged as the fastest growing market for chocolate with the chocolate market growing at a rate 15 per cent per annum. India produced 14.4 thousand tonnes of cocoa beans from an area of 56 thousand hectares during 2012-13.

Spices

India has been a traditional producer, consumer and exporter of spices and almost all states in the country produce one or other spices. During the crop year 2012-13 the country produced about 5805 thousand tons from 3100 thousand hectares of area under spices. Of the total production, nearly 9.5% was exported. Share of export in total production varied from a mere 0.6% in tamarind to about 72% in nutmeg and mace. The spices export has continued its growth with 7.26 lakh tonnes worth 2.21 billion US $, an all-time high both in terms of volume and value of spices export from India. Spices have tremendous importance in everyday life of human being, as ingredients in food, medicine, perfumery, cosmetics, etc. They also have anti-oxidant, antimicrobial, pharmaceutical and nutritional properties and therefore their potential as a functional food has magnified scope. Value addition and product development in spices need greater thrust and urgent intervention. According to Transparency Market Research, the Global Seasonings and Spices Market is expected to each USD 16.6 Billion in 2019. We must exploit it with equitable sharing of responsibilities and profits.

Major challenges in plantation crops

The fact that the livelihood security of significant number of small holder producers is dependent on this sector makes it imperative that the plantation crop economy shows vibrant growth. Despite these efforts, plantation crops have been continuously facing the problem of under investment and low capital formation. The yield levels of some of the crops in the sector like coffee and arecanut continue to be well below the desired levels in comparison to the global average productivity level.

The plantation crop sector has shown considerable inertia to adopt modernization in post harvest operations, technology adoption and mechanization. There is an urgent need for modernization of the plantation crop sector and allied activities. The technologies available, especially in mechanization of operations, are often not suitable for adoption in small holdings. Developing suitable marketing channels and value chains suited for widely disaggregated pro-



duction environment is one of the biggest challenges faced in almost all the plantation crops.

The increase in demand for the products did not translate to higher prices due to the rise in productivity of the crops and consequent increase in supply of the commodities. The productivity enhancement did not benefit the primary producer of the commodity and the benefits mainly went to the consuming classes. The depressed prices of the commodities continue to be a major challenge in plantation crop sector.

The unexploited latent potential for value addition and the need to enhance the relevance and role of research and developmental institutions working in the sector. High level of microbials including mycotoxin and toxic chemicals in the finished products, adulteration of spice products and lack of awareness among producers about MRL and acceptable daily intake (ADI) standards for export pose threat to the export of processed and value added products from this sector.

Climate Change

Climate Change affects everyone every day. It affects food security, habitat security and economic security. The increase in temperature, irregular rainfall and drought leads to changes in breeding strategy. Flowering behavior, effect on pollen fertility and increased flowering time, need attention. There may be reduction in yield and quality in traditional areas but may lead to better suitability in non-traditional areas (newer areas will be more suitable), new disease and pest out breaks and loss of geographical indicators (GI). Plantation crops and Spices, though effected by climate change can actually play a role (especially the perennial types) in mitigation of climate change through carbon sequestration and better utilization of GHGs in a typically high density multispecies cropping system

Policy options and road map for future

- The small holder perspective in research needs to be emphasized in plantation crops considering the structure of operational holdings in this sector. Technologies appropriate for small holdings need to be developed for faster and wider technology adoption in the crops.
- Develop innovative platforms of research for addressing knowledge gaps in plant physiology, abiotic stress tolerance, assimilate partitioning etc.
- Scope for crop improvement especially to develop genotypes resistant to biotic and abiotic stresses and also responsive to low input management through conventional breeding and biotechnological approaches.
- Public- private industry partnership to identify potential problems and workable solutions
- The bulk of the production of plantation crops is concentrated in limited geographical



area. Identifying the major crop ecological zones of each plantation crop and ensuring the availability of all physical, financial and institutional support in those areas can help in promoting intensive cultivation of the crop.

- The sustainability of the existing production practices also need to be carefully scrutinized for their environmental viability and economic sustainability.
- The inclusive development of the sector should be targeted through addressing the constraints faced in aggregation of the produce for marketing, value addition through the promotion of farmer producer organizations (FPO) and farmer producer companies (FPC) in the sector.
- The role and importance of crop diversification and consequently income diversification need to be conveyed to many plantation crop producers to reduce the market risk and enhance the livelihood security. Growing medicinal trees/plants in plantations can be one example where we can meet the huge requirement of raw materials required for health care through ayurveda at the same time get additional income with very little investment.
- The adoption of mechanization needs to be promoted through suitable policy incentives so that higher efficiency in production can be attained. Small machinery appropriate for small holdings needs to be given emphasis in the drive for enhancing mechanization.
- Efforts should be taken to reduce the export concentration in favour of limited number of markets. Diversifying the destinations and deepening the market for exported produce can significantly increase the options to reduce price fluctuations and market risk.
- The traded nature of the commodities and the inherent dependence of the sector on weather parameters makes plantation crop sector vulnerable to income risk. Diverse crop insurance tools suited to specific crops and for producers with diverse risk appetite need to be developed to address the situation.
- The synergy from the developmental efforts of the various institutions that exist for specific purposes and crops need to be channeled through better institutional linkages and cross disciplinary approach to address common challenges in the sector.
- The Gender dimension should be mainstreamed in all programmes.

Priorities in the plantation crops sector

Agricultural

- Decreasing land resources – higher productivity per unit area
- Some important oilseed crops are in the plantation crop sector



- Intelligent development and deployment of stress (biotic and abiotic) tolerant, low input responsive varieties and precision farming – integrated, optimal and ecologically safe technologies
- Plant and soil health management
- Conservation agriculture and judicious utilization of water resources
- Labour shortage and mechanization
- Value addition and new product development for better returns and market competitiveness
- Up gradation of technology across the entire supply chain to meet the industry needs a key driver of growth
- Optimal use state-of-art IT and nano technologies in plantation sector
- Knowledge dissemination and sharing

Environmental

- Climate resilience and carbon sequestration

Regulatory issues

- Residues and food safety
- Regulatory issue during export
- Labour laws and policy initiatives

Trade and financial issues

- Farmer producer companies for better distribution of returns
- Aggressive marketing
- International trade, unstable markets and market intelligence
- Crop insurance and MSP

Social issues

- Livelihood of plantation workers
- Health concerns



- Equitable growth of all concerned

This year is the 'International Year of Family Farming', which is aimed to stimulate policies for the sustainable development of farmer families, communal units, indigenous groups, cooperatives and fishing families.

As emphasized earlier, technologies appropriate for small holdings that encompasses a family need to be developed for faster and wider adoption in the plantation crops sector. Apparently, family and small-scale farming are inextricably linked to world food security. This provides the opportunity to boost local economies, especially when combined with specific policies aimed at social protection and well-being of families.

The bane in plantation crops sector is the widespread evidence of low wages, long hours, and poor housing and health risks for plantation workers around the world. Besides, wives and children have been called upon to help men in the field.

Conversely, we need to make plantation employment an opportunity to diversify income sources and raise cash for special purposes. The foundations have been laid. It is about looking ahead, to explore the pressures that are brought to bear upon family farming. We need to focus on structural changes and focus on the Family-First paradigm. Considering that a vast majority of the plantations, be it rubber, tea or coffee are owned by the conglomerates with commercial interests, for a small family to venture into this sector, we need a range of support measures, including tax breaks and rural infrastructure provision as well as substantial finance from donor agencies keen to support the families involved in the plantation sector.

Be that as it may, the year 2015 is the International Year of Soils. While trying to enhance crop yields, we have been literally, with disdain, abusing the soil, the world over. The Green revolution did not ever say that we ignore our soil. I reiterate the statement of UN that 'healthy soils are the foundation for food, fuel, fibre and even medicine'. The UN kicked off 2015 as the International Year of Soils, in an effort to raise awareness and promote more sustainable use of this critical resource.

Quoting the Director General of FAO, José Graziano da Silva "Unfortunately, 33% of our global soil resources are under degradation and human pressures on soils are reaching critical limits, reducing and sometimes eliminating essential soil functions. If we had been more aware, more circumspect, our soils would have been healthier and resilient. But it is not late...

Soils are not a 'Forgotten Resource'. In fact, they are vital, they are the basis for food, feed, fuel and fibre security.

I will like to end by referring to four issues

1. Role of Genetic Engineering



2. Nutraceuticals and Value Addition
3. Inter-cropping of Medicinal and Aromatic Plants
4. Farm Schools – Farmer to Farmer Transfer of Technology
5. Contribution to meeting the Zero Hunger Challenge

1. Role of genetic engineering

It an era of Climate Change, we will need varieties of plantation crops which can withstand adverse changes in temperature, precipitation and sea level rise. The Rubber Research Institute at Kottayam has evolved through genetic modification heat tolerant strains. We however need a policy for field testing of GMOs and for assessing risks and benefits in a scientifically credible and socially acceptable manner.

It is 61 years since the beginning of the new genetics based on the discovery of the double helix structure of the DNA molecule by Watson, Crick and Wilkins. It is also 31 years since the production of transgenic plants started, thanks to the work of Marc Von Montagu, Jeff Shell, Mary del Chilton and several others. The first patent for a living organism went to Dr Anand Chakraborty who developed through recombinant DNA technology an organism for cleaning up oil spills. The science of molecular genetics has been applied with great benefit in the fields of medicine, industry, environment and agriculture. In the case of medicine, the public have been experiencing several beneficial fallouts such as new vaccines, insulin and genetic medicine. The major concern in medical genetics is one of ethics, as for example, the application of recombinant DNA technology for reproductive cloning. Therapeutic cloning, on the other hand, has been welcomed. In the case of environmental biotechnology, there is great interest in bioremediation methodologies since there is growing pollution of ground and river water. In food and agricultural biotechnology there are public concerns about biosafety, environmental safety, biodiversity loss, and human and farm animal health.

In the case of technologies which carry both benefits and possible risks, it is important to have regulatory mechanisms which can help to analyse risks and benefits in an impartial, transparent and professionally competent manner. This is why the Government of India introduced last year in Parliament a Biotechnology Regulatory Authority Bill. Unfortunately the validity of this Bill from the point of view of debate and decision has now expired with the conclusion of the term of the previous Lok Sabha. This gives ICAR, DBT, ICMR, CSIR, UGC, Ministry of Environment and Forests and other agencies a wonderful opportunity to go through the text of the Bill once again, taking into account the numerous comments, criticisms, and suggestions which have been received, and a get a new Bill prepared for introduction in the current Parliament. While it may take time to set-up a Parliament approved National Biotechnology and Biosafety Regulatory Authority, guidelines for safe field testing should be developed. Enforcement of procedures for the release of GMOs for commercial cultivation may take time,



but field testing under well-defined safeguards should go on. There are numerous GM varieties in the Breeders' Assembly Line, and they should be tested in the field without further delay. Meanwhile, procedures for their release can be finalised through appropriate discussion and legislation.

An Agricultural Biotechnology Committee which, I chaired in 2003 and which submitted its report early in 2004 had recommended both a Parliament approved Regulatory Agency as well as the necessary infrastructure for conducting All India Coordinated Trials with GMOs. Such a special All India Coordinated Trial to be organised by the ICAR should have as its Coordinator an eminent Biosafety Expert. The necessary precautions, such as the needed isolation as well as demonstration of the importance of refuge, should be undertaken under this coordinated project. Ten years have passed since this recommendation was made and we should lose no further time in implementing it. We should place in position a trial and safety assessment system which answers the concerns of anti-GMO experts and environmental organisations. The present moratorium on field trials with recombinant DNA material is serving as a serious handicap as well as a disincentive in harnessing the benefits of the wide array of transgenic material currently available with various public and private sector research organisations and universities. Many of the GMOs in the breeders' assembly line have excellent qualities for resistance to biotic and abiotic stresses as well as improved nutritional properties. Much of this work has been done in institutions committed to public good. Also, much of the work has been done by brilliant young scientists who are getting discouraged because of the lack of a clear official signal on the future of genetic modification in agricultural research.

While urgent steps are needed for putting in place a widely accepted regulatory system, full advantage should be taken of the molecular marker assisted selection procedures of breeding. Many of the desired goals can be achieved through marker assisted breeding. Varieties developed through marker assisted selection are accepted for organic certification. Agriculture is a state subject and it is very important that the State Agricultural Universities and State Departments of Agriculture are involved in the design and implementation of the field trials. It takes nearly 10 years for a new variety to be ready for cultivation by farmers. Therefore speed is of the essence in organising field trials and gathering reliable data on risks and benefits.

Return from investments in biotechnology research is high. The Public Sector institutions should accord priority to the development of high yielding climate smart and disease resistant varieties, while obviously the private sector will prefer to produce hybrids whose seeds will have to be ought every year by farmers. Public and private sectors should develop a joint strategy which will help to ensure the inclusiveness of access to improved technologies among all farmers, small or large. The Public Sector R&D institutions should give high priority to the breeding of varieties which can help farmers to minimise climate and market risks.

There is need for PAN-political support for promoting safe and responsible genetic engineering research. Every research institution should have a Project Selection Committee which will examine carefully whether recombinant DNA technology is necessary to achieve the



desired breeding goal. In many cases, marker assisted selection would be adequate for developing a variety with the necessary characters. Recombinant DNA technology should be resorted to only when there is no other way of achieving the desired objective.

The report of the Parliamentary Committee headed by Shri Basudeb Acharya (2012) has to be carefully studied and the suggestion of the Committee that we should set up a Biosafety Regulatory Authority on the Norwegian Model should be examined for appropriate action and adoption.

2. Nutraceuticals and value addition

An area which merits additional research is the medicinal properties of many Indian spices notably turmeric, pepper and garlic. Apart from their own inherent beneficial pharmacological properties, some of the active ingredients such as curcumin, tetrahydrocurcumin, C3curcuminoids (from turmeric), piperine (from pepper), allyl sulphides and other Sulphur containing compounds (from garlic)etc are already being marketed as anti-oxidants and nutraceuticals , for wound healing , as bio enhancers etc. A hybrid Selenium fortified Garlic variety has been developed since Selenium is of great value as a free radical scavenger and therefore is an immune-potentiating agent. World's leading institutions in the Cancer area such as the M.D. Anderson cancer centre, National Cancer Institute and others have active programmes for the development of anti-cancer compounds from some of the Indian spices. One of the impediments for investments in this area is related to the difficulty in getting strong IP (patents) protection for natural products and known active ingredients. MNCs therefore shy away from investments in this area. India with its rich tradition of Indian systems of Medicine should take a lead in this area since many of the spices could possibly have important therapeutic utility as evidenced by their usage in these systems for example in Rasayana therapy. Since there is increasing interest in promoting preventive approaches to management of diseases, spices do have a role to play in prophylactics and therapeutics. An integrated research programme should be initiated sponsored by the Spices Board to carry out pre-clinical and clinical research.

3. Inter-cropping of medicinal and aromatic plants

Ayurveda is being accepted globally as a holistic health care system with time tested principles and practices. The mainstay of Ayurveda is the wide variety of medicinal plants which are obtained mainly from the wild. But now our forests and natural habitats stand highly depleted and degraded and this exerts tremendous pressure on such herbal systems of medicine. Over- exploitation and unsustainable harvesting also lead to scarcity of medicinal plants and consequent adulteration and substitution with spurious alternatives. For example, nearly 4 lakhs kilograms Bael root (*Aegle marmelos*), an ingredient of Dasamoola, are required in Kerala per year. As it is not available in required quantities, the root of another Rutaceae plant *Atlantia monophylla* is supplied in the market. About 2 lakh kilograms of Asoka bark is required in Kerala per year. In the place of *Saraca asoca*, the bark of 3 or 4 other trees are sold in the market.



This tells upon the efficacy of the drugs and ultimately erodes the credibility of the system in public minds. By undertaking pharmacognostic studies using anatomical and phytochemical parameters, reference standards of genuine herbs used in Ayurveda can be made and by comparing the profiles of subsequent samples with that of genuine drugs, adulteration can be found out and checked at the floor level.

Promotion of conservation and cultivation enlarge the resource base of medicinal plants in the country which enable uninterrupted supply of genuine herbs to the industry. Medicinal and Aromatic Plants (MAPs) are looked upon not only as a source of health care products, but also as a source of income. The global importance of MAPs due to huge volume of trade at National and International levels has been highlighted in many reports. The Task Force report indicated that international market for medicinal plants is over US $ 60 billion per year and herbal drug market continues to grow at the rate of 7.3% annually (GOI, 2000). As per the estimate of the World Health Organisation, the global market for plant based medicine will hit 5 trillion US$. As there is no scope for horizontal expansion of cultivated area, it is viable to grow MAPs as intercrops with the predominant crops of the region by devising suitable cropping schedules.

Many medicinal plants can be successfully cultivated as intercrops among plantation crops like coconut, arecanut, rubber, coffee, tea etc.

Plants that can be successfully grown in coconut gardens as intercrops are *Adhatoda vasica, Tricosanthus cucumerina, Piper longum, Desmodium gangeticum, Asparagus racemosus* etc.

Agrotechniques have been developed for medicinal and aromatic plants as intercrops in arecanut plantations. For example, *Vetiveria zizanioides, Asparagus racemosus, Piper longum, Aloe vera, Nilgirianthus ciliatus* etc.

It has been proved that medicinal plants can be grown as intercrops in rubber plantation. In the early three years after planting rubber, the following plants can be cultivated.

1. *Desmodium gangeticum*, 2. *Pseudarthria viscida*, 3. *Intigofera tinctorea* (these papilionaceous plants can also enrich soil if grown as intercrops), 4. *Piper longum*, 5. *Curcuma longa*, 6. *Kaempferia galanga.*

After three years, shade loving plants like *Nilgirianthus sciliatus* can be successfully cultivated.

In coffee estates, plants that can be grown successfully as intercrops are *Oroxylum indicum, Premna serratifolia, Gmelina arborea* etc. On borders *Adhatoda vasica* and *Vitex negundo* can be grown.

In Cardamom estates, as shade trees, *Gmelina arborea, Aegle marmelos, Oroxylum indicum* and *Stereospermum* sps. can be grown.



In tea estates, for border planting, *Adhatoda vasica, Vitex negundo, Premna serratifolia, Solanum indicum* and *Hibiscus rosasinensis* can be used.

The Centre for Medicinal Plants Research of the Arya Vaidya Sala, Kottakkal headed by Dr Indira Balachandran will be able to provide technical guidance in this area.

4. Farm Schools – Farmer to Farmer transfer of technology

Farm families are playing an important role in conservation, cultivation, consumption and commerce as related to Plantation Crops. Farmer – to – farmer learning is a powerful method of extension. MSSRF is therefore establishing Farm Schools in Wayanad with financial support from the Indian Overseas Bank. Farmers function as breeders, cultivators and conservers. For example, Shri Joseph Njallani of the Idukki district has bred several of the most popular varieties of Cardamom. "Every farmer a field scientist" should be our goal.

5. Contribution to meeting the Zero Hunger Challenge

The UN has called for achieving the goal of "Zero Hunger" by 2025. Many of the tribal areas like Attapadi, where plantation crops are grown, are unfortunately affected by severe malnutrition, particularly among women and children. The plantation crops industry can help to overcome this problem through a two pronged strategy, namely, nutrition literacy and promotion of Farming Systems for Nutrition (FSN). Biofortified crops like Moringa, Bread fruit, Jack fruit, Sweet Potato, etc can be grown as intercrops. "Zero Hunger" should be the goal of the Plantation crop industry in its areas of operation. If this is done every plantation will produce not only coffee, or rubber, or tea, etc. but will also become a "Nutri-Farm", which provides agricultural remedies to the nutritional maladies prevailing in the area.

I wish the International Symposium on Plantation Crops much success



SESSION I

VARIETAL WEALTH: GERMPLASM, GENETICS AND BREEDING

10 December 2014

The session was chaired by Dr. K. V. Peter, Director, World Noni Research Foundation, Chennai and Dr. P. L. Saroj, Director, ICAR-Directorate of Cashew Research, Puttur. Dr. Jeena Devasia, Asst. Plant Breeder, Central Coffee Research Institute, Balehonnur and Dr. Sharon Aravind, Scientist, ICAR-Indian Institute of Spices Research, Regional Station, Appangala were the rapporteurs for this session. One lead lecture, six oral and 54 poster papers were presented in the session.

Lead lecture

1. *Breeding strategies in perennial crops with special reference to oil palm*: Dr. N. Rajanaidu, Malaysian Palm Oil Board, Selangor, Malaysia.

Oral Presentations

1. *Development of Kalpa Samrudhi-A Dwarf x Tall Coconut Hybrid at ICAR-CPCRI*: Dr. B. Augustine Jerard
2. *Breeding for dwarfness in oil palm: Performance of selfed progenies of Dwarf Tanera*: Dr. Sunil Kumar
3. *Genetic architecture of cashew germplasm*: Dr. G. S. Mohana
4. *Analysis of genome integration pattern in coffee hybrids using SRAP markers:* Dr. M. K. Mishra
5. *Identification of potential drought tolerant Hevea germplasm accessions using physiological and biochemical parameters*: Dr. Molly Thomas
6. *Controlled pollination and establishment of first generation inbreds and inter varietal hybrids in turmeric*: Dr. R. Ramakrishnan Nair.



Major recommendations

1. To develop varieties in plantation crops based on farmers demands like multiple disease and pest resistance.

2. To develop international cooperation in oil palm research

3. To test the performance of the coconut hybrid 'Kalpa Samrudhi' all over India and also to produce sufficient quantity of seed materials.

4. To analyze the influence of G x E effects on the performance of germplasm lines in cashew



SPECIAL SESSION

FARMER-ENTREPRENEUR-RESEARCHER INTERFACE

10 December 2014

The session was chaired by Dr. J. Thomas, Director (Research), Indian Cardamom Research Institute, Myladumpara and Dr. K. Prathapan, Mission Director, State Horticulture Mission, Thiruvananthapuram. The rapporteurs of this session were Dr. M. V. Prasad, Principal Scientist, ICAR-Directorate of Oil Palm Research, Pedavegi and Dr. P Manoj, Programme Co-ordinator in Charge, Krishi Vigyan Kendra, Peruvannamuzhi, Kozhikode.

Lead lectures

1. *Natural rubber industry-present crisis, concerns and future directions*: Mr. Santhosh Kumar, Vice President (Rubber), Harrison Malayalam Limited, Kochi

Abstract: The Natural Rubber Industry in India is in the middle of a very severe crisis at present triggered by the steep fall in prices of natural rubber. The prices of rubber which are far below the cost of production have not only made the cultivation uneconomical but are also forcing cultivators to move out of the crop or seek alternate sources of income. Rubber was a crop which had the rare distinction of having the highest farm gate price for any agricultural commodity in the world. The model of rubber cultivation, formulated and emulated by Government, the Commodity Boards and cultivators over a period of time had led to the high farm gate prices for the farmer. This has also lead to extension of this crop to non -traditional areas and regions of the country and is being seen as a vehicle for sustained economic development of these areas. Along with extensive cultivation of this crop, a strong processing and manufacturing industry has evolved in the country leading to a good and stable demand for natural Rubber within the country. Rubber cultivation has undergone several changes and today rubber has become a strategic commodity in the basket of commodities traded across the world. This presentation tries to look into the factors that has contributed to this down fall in prices , the challenges faced by the industry, the model of cultivation, production, processing and consumption as also some thoughts on the interventions required so as to have a sustainable and robust growth for the Industry in the days to come.

2. *Role of farmer producer companies in marketing of agricultural produces*: Dr. D. Venkateswaran, Director, Ulavan Producer Company Ltd. Erode



3. *Cultivation of coffee without shade*: Mr. J. N. Jagath Bhushan, Planter, Blue Moon Estate, Bandhalli, Hassan District, Karnataka

Major recommendations

1. Multiple cropping needs to be promoted in plantation crops.
2. Strategies to bring stable market for plantation crops products need to be developed.
3. Quality standards for private clonal nurseries need to be ensured.
4. A price stabilization fund/crop insurance needs to be formed.
5. Sustainability and quality should be given equal importance.
6. Crop intensification in rubber plantations should be promoted in immature and mature stages of growth of rubber.



PANEL DISCUSSION SESSION

RESEARCH AND DEVELOPMENT IN PLANTATION CROPS-THE WAY FORWARD

The panel discussion on 'Research and Development on Plantation Crops' was chaired by Dr. P. Rethinam, Former Executive Director, APCC, Jakarta and Dr. M. Anandaraj, Director, ICAR-Indian Institute of Spices Research, Kozhikode. Dr. Bindu Roy, Senior Scientist, Rubber Research Institute of India, Kottayam and Ms. H. J. Akshitha, Scientist, ICAR-Indian Institute of Spices Research, Kozhikode served as rapporteurs for this session.

The panelists were: Dr. K. V. Ahamed Bavappa, Former Director, ICAR-CPCRI, Kasargod; Dr. N. M. Nayar, Former Director, ICAR-CPCRI, Kasargod; Dr. K. U. K. Nampoothiri, Former Director, ICAR-CPCRI, Kasargod; Dr. K. V. Peter, Former Director, ICAR-IISR, Kozhikode; Dr. M. G. Bhat, Former Director, ICAR-DCR, Puttur; Dr. Mohan Kumar, Former Director, UPASI Tea Research Foundation, Valparai; Dr. V. S. Sharma, Former Director, UPASI Tea Research Foundation, Valparai; Dr. S. Edison, Former Project Coordinator, AICRP on Spices, ICAR-IISR, Kozhikode and Dr. V. S. Korikanthimath, Former Director, ICAR- Central Coastal Agricultural Research Institute, Goa.

Dr. P. Rethinam in his introduction emphasized the importance of transfer of technology and availability of viable technologies developed by researchers to farmers. Before opening the forum to the panelists to bring out their views, he invited the farmers to interact and give their suggestions on their expectations from plantation crops scientists. Dr. M. Anandaraj emphasized the importance of the panel discussion, which would be helpful for setting both short and long term goals for research.

Major recommendations

1. Review of the recommendations of all PLACROSYMs may be made and how far the decisions are being implemented may be reviewed.
2. Research priorities should be need based to solve the problems of farmers and to create sustainability in plantation crops sector.
3. Any subsidy program of government should have a technical recommendation.



4. Quality planting material of plantation crops may be made available through registered nurseries.

5. Transfer of technology and supply of nucleus planting materials should originate from the concerned research institutes/organizations. Adequate training need to be given in planting materials production.

6. Identification of determinate genes and evolving varieties for dwarfness should receive attention to resolve the hazards of harvesting.

7. Deviation from monocrop to multicrop should be the future thrust so that continuous income, employment potential, maintaining soil health, providing livelihood and social security will be possible.

8. Crops like kokum should receive more attention in terms of developing varieties, technologies and value addition.

9. Product diversification, value addition and development of high value products in plantation crops need attention.

10. Inter institutional collaborative research programmes for cropping/farming systems and pest and disease management should be developed.

11. Use of new tools like nanotechnology, molecular breeding and genomic research should get priority in plantation crops research.



SESSION II

PRODUCTION SYSTEMS: AGRONOMY, SOIL SCIENCE, PHYSIOLOGY AND BIOCHEMISTRY

11 December 2014

The session was chaired by Dr. James Jacob, Director, Rubber Research Institute of India, Kottayam and Dr. Y. Raghuramulu, Director (Research), Central Coffee Research Institute, Balehonnur. The rapporteurs of the session were Dr. C. K. Thankamani, Principal Scientist, ICAR-Indian Institute of Spices Research, Kozhikode and Dr. R. Chitra, Assistant Professor, Tamil Nadu Agricultural University, Coimbatore. In this session, 1 lead talk, 7 oral and 59 posters were presented.

Lead lecture

1. *Tea Research: Is it sustainable? (or is sustainability unsustainable)*: Dr. M. K. V. Carr, Professor Emeritus, Agricultural Water Management, Cranefield University, Bedfordshire, UK

Abstract: Using the experience of running a research project in Tanzania on tea irrigation and, over the same period, helping to establish a national tea research institute, this paper explores the successes and weaknesses of the project, and the lessons to be learned. Research units do not have to be large to be successful but it is important that staff identify fully with the industry they are serving, and share the challenges it faces. A balance has to be struck between solving short-term practical problems of local interest only and the need to understand the science. The recommendations have to be tailored to suit (1) the diversity of ecological areas where tea is grown, (2) smallholders who have limited resources to devote to tea, as well as (3) an innovative estate sector who want only the best. This is not an easy task, as not only do the soils vary, but the climates range from sub-tropical to temperate. Donors can upset this balance by concentrating resources on what may be fashionable at that time. A small research organisation can suddenly become unsustainable when the money stops, as it always does, and the staff are left with an infrastructure that cannot be maintained. In the meantime they may have lost the support of the key levy payers, their primary stakeholder. Lack of continuity of funding is always an issue, and Governments do not always make it easy! All three tea research institutes in East Africa have suffered in this way. Effective communication is a key requisite if tea research is to be sus-



tainable. Researchers are required to report their results in Annual Reports. These are usually boring with little attempt to interpret the data in thought-provoking ways (and they are often delivered several years late). Specialist conferences are useful but the papers can be variable in quality. There is also limited cross fertilisation of ideas from other crops. The papers are also not judged against international standards, as peer-reviewed papers are (or should be). Researchers and industry need to be mutually supportive. The tea irrigation research project, despite intermittent funding, helped the tea sector in Tanzania to survive through difficult times. Two of the most modern tea estates in the world have been established in non-traditional tea locations in Southern Tanzania. They are both fully mechanised and irrigated. An innovative extension service (self-funding), supporting 12,000 farmer families has now been operating for 12 years. Does a history of interrupted funding like this mean that tea research in Tanzania is sustainable (just) or, if we are honest, is it not really showing that research is a marginal activity (only kept alive by committed individuals)?

Oral presentations

1. *Soil fertility and coconut productivity improvement of mixed farming and nutrient management practices in coconut based cropping system*: Dr. V. Selvamani
2. *Performance of high density planting system for yield maximization in cashew under maiden parts of Karnataka*: Dr. M. K. Honnabyraiah.
3. *Soil related constraints to plantation crop production in Kerala*: Dr. K. M. Nair
4. *Modified planting designs and canopy management practices for sustainable coffee production in Indian coffee plantations*: Dr. C. Babou
5. *Influence of humic acid with organic and inorganic fertilizers on yield, nutrient status and quality of mature tea*: Dr. K. Poobathiraj
6. *Latex regeneration mechanism in Hevea: Role of lutoid membrane transport and protein synthesis*: Dr. R. Krishnakumar
7. *A novel method to produce orthotropic, plagiotropic and single noded cuttings of black pepper in soil less medium*: Dr. K. Kandiannan

Major recommendations

1. In coconut based mixed farming system, it was suggested to work out the B:C ratio of the system and to study the impact of organic and inorganic fertilizers on soil properties.
2. For the amendment of soil related constraints to plantation crop production in Kerala,



application of magnesium, lime and boron can be taken up in deficient soil.

3. In cashew plantations, the concept of the high density planting requires proper canopy management rather than removal of trees in a row during the growing period.

4. In coffee plantations, among the pruning treatments, hedge row system of planting with rock-n-roll/cyclic pruning recorded maximum yield and less incidence of white stem borer.

5. In the novel method of producing black pepper cuttings in soil-less medium, leaflet on plant protection measures may be provided while supplying the planting materials.



SESSION III

PLANT HEALTH MANAGEMENT: PATHOLOGY, ENTOMOLOGY, NEMATOLOGY

11 December 2014

The session was chaired by Dr. S Edison, Former Director, ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram and Dr. B. Radhakrishnan, Director, UPASI Tea Research Foundation, Valparai. The rapporteurs of this session were Dr. R. Suseela Bhai, Principal Scientist, ICAR-Indian Institute of Spices, Research, Kozhikode and Dr K. K. Srikumar, Scientist, UPASI Tea Research Foundation, Valparai. Three lead papers, 7 oral and 66 posters were presented.

Lead lectures

1. *Phytophthora*: *A global pathogen*: Dr. M Anandaraj, Director, ICAR-Indian Institute of Spices Research, Kozhikode, Kerala, India.

Abstract: *Phytophthora* – one of the most devastating plant pathogens is a fungus like-hemibiotroph belonging to Oomycetes requires living host cells in the initial phase of colonization, necrotizes host tissue and produces reproductive structures on the necrotic tissue. Spore type depends up on the weather conditions and highly dependent on weather. Anton de Bary was the first who coined the name *Phytophthora* "The plant destroyer" in 1876 when he described the Potato late blight pathogen, *Phytophthora infestans* as the type species of his new Genus. For over 10 years *P. infestans* was the only species of the genus that was recognized in the plant pathology literature. *P. cactorum* was described in 1886 followed by *P. phaseoli* in 1889 and *P. nicotianae* in 1896 .Up to the year2000 only 58 species were described by the year 2011 over 114 listed due to the availability of molecular tools and the number is growing rapidly. *Phytophthora* affects crops that are herbaceous, hard wood trees and palms. The symptom expression depends on the plant part affected and the extension of damage. Feeder root damage goes unnoticed and results in yellowing and decline in health of perennial tress. Symptoms on fruits, leaves, and petiole are brown to purple lesions but soon colonized by saprophytes resulting in wood discoloration often leading to erroneous etiology. *Phytophthora* has been traditionally considered by plant pathologists as devastating pathogen. Recent studies show trophically complex communities namely; aquatic opportunists, foliar pathogens and soil borne fine root /canker pathogens. *Phytophthora* has been a major disease causing agent in India on agricultural and horticultural



crops. The Indian Council of Agricultural Research has taken a major initiative on a project in network mode involving three pathogens namely *Phytophthora, Fusarium* and *Ralstonia* (www.phytofura.net.in) that is being operated in 18 Institutions across the country with ten institutes working on *Phytophthora*. The major programmes are on collection and diversity analysis based on morphology and molecular tools, development of diagnostics, understanding the host pathogen interaction and eventually to develop robust management strategies. Molecular basis of disease resistance and deploying novel genes and products to manage diseases are some of the stated objectives. The whole genome sequence of two isolates have been done and the annotation revealed the genome size to vary from 46 to 64Mb whereas globally it is reported to range from 64 to 240, the highest in *P. infestans* due to repetitive gene sequences. Based on Genomics and Bioinformatics, a sequence repository was designed and developed to store the sequences generated under the project. Genome assembly and annotation of *Phytophthora* isolates infecting black pepper was further refined with new *in silico* tools. Around 1440 unique domain super families and 52 effector domains related to pathogenesis present in *P. capsici* (05-06) genome were identified through comparative genomics. The new data generated is helping us to unravel the species complex present in the disease symptoms and the methods to manage the diseases.

2. *Naturalist inspired chemical ecology*: Dr. Shannon Olsson, Reader, National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bengaluru, Karnataka, India

Abstract: Chemical communication is the ubiquitous language of our natural world and the field of chemical ecology examines the role of chemical interactions between organisms and their environment. The study of chemical ecology can therefore provide insight into biological processes and generate ecological solutions for agriculture, manufacturing, and medicine. By all accounts, insects are masters of our animal kingdom. In fact, estimates suggest there are 100 times more species of insects than any other animal taxa. Insects are also known for their exquisite olfactory capabilities and use chemicals to locate mates, food, egg-laying sites, and to avoid danger, among others. Our research employs a comparative approach to understand how different insects locate odor sources in the complex natural world. Localizing odor sources in nature's noisy chemical background is an immense computational task. What we perceive as a single odor, like rose or coffee, is generally many different molecules creating an odor blend. This blend then travels through the air as discrete packets within a turbulent odor plume. Our work in moths suggests that natural odors can be considered "objects" in much the same way we consider visual objects as composite images. The antenna first filters relevant odors from the environment, then the antennal lobe of the moth brain extracts composite "odor objects" from chemical blends. Our work in *Drosophila melanogaster* also suggests that insects have evolved a unique signaling mechanism to rapidly detect and locate these complex odors while in flight. Finally, our comparative analyses across species imply that different insects define these odor objects at different levels of the brain depending on their ecology. Determining how insects make odor choices in their environment is not only an essential component to understand animal decision making, but can help develop effective pest management strategies and predict



the impact of invasive species, climate change, and human disturbance on insect host choice.

3. *eKisanSaathi: Delivering pro-active actionable agricultural advice to poor and marginal farmers*: Dr. P Krishna Reddy, Professor, International Institute of Information Technology, Hyderabad, Andhra Pradesh, India.

Abstract: Since 2004, by extending the developments in ICTs to agriculture, an effort is being made by IIIT Hyderabad to build personalized agricultural advisory system called eSagu (The word "Sagu" means cultivation in Telugu language). The eSagu system aims at providing customized agricultural expert advices to each farm in a timely manner at regular intervals (week to fortnight depending on criticality of crop advice), throughout crop growing period. The expert advice is generated by agricultural experts based on the latest information about the crop situation received in the form of both digital photographs and corresponding feedback text. The impact results show that the expert advice helped the farmers to improve the crop production efficiency by encouraging integrated pest and nutrient management. It was also found that the farmers have realized considerable monetary benefits by reducing the quantity of fertilizer application, pesticide sprays, besides getting the additional yield. From 2011, efforts have been made to develop eKisanSaathi system to deliver the location and crop specific advice to all farmers, including poor and marginal farmers, in a cost-effective manner. The implementation results are encouraging. In this talk, I explain the background, system architecture, operational procedure and discuss the advantages and issues of eKisanSaathi system.

Oral presentations

1. *Analysis of differential expression of defense-related genes responsive to root (wilt) disease in coconut*: Dr. K. E. Rachana

2. *Efficacy of pheromone lures in the management of coconut rhinoceros beetle*: Dr. T. Srinivasan

3. *Defence system against white stem borer discovered in coffee*: Dr. Hosahalli Lakkanna Sreenath

4. *Production of recombinant monocot mannose binding lectin and its application in tea*: Dr. K. N. Chandrashekara

5. *Efficiency of a green lacewing predator in controlling red spider mites*: Dr. B. Radhakrishnan

6. *Reaction of promising RRII 400 series Hevea brasiliensis clones to pink, Colletotrichum and abnormal leaf fall diseases*: Dr. Annakutty Joseph

7. *Genetic and functional analysis of plant endophytic Bacillus megaterium BP17 isolated from black pepper roots*: Ms. Vibhuti Munjal



Major recommendations

1. Practical training has to be imparted to Agricultural Officers in collaboration with Coconut Board to transfer the advanced technologies developed in coconut for the revival of coconut gardens in Kerala.

2. The elucidation of defense mechanism against white stem borer of coffee is suggested for patenting.

3. The trials with recombinant monocot binding lectin against tea blister blight have to be repeated for two more years before recommendation.

4. Trials on evaluation of green lacewing predator in controlling red spider mite may be conducted in other locations too.

5. The prominent rubber accession RRII 105 may be barcoded..



SESSION IV

VALUE CHAIN MANAGEMENT, POST-HARVEST TECHNOLOGY, ECONOMICS

11 December 2014

The session was chaired by Dr. M. R. Sudharshan, Former Director (Research), Indian Cardamom Research Institute, Myladumpara. Dr. N K Leela, Principal Scientist, ICAR-Indian Institute of Spices Research, Kozhikode and Dr. M. R. Manikantan, Senior Scientist, ICAR-Central Plantation Crops Research Institute, Kasaragod were the rapporteurs. In this session there was 1 lead lecture, 3 oral and 18 poster presentations.

Lead lecture

1. *A value chain on utilization of banana pseudostem for fibre and other value added products*: Dr. P. Rethinam, Former Executive Director, APCC, Jakarta

Abstract: Banana is grown in around 0.7 million ha and generates 56 billion kg waste (@ 0.08 million kg/ha) in the form of pseudostem. Baseline survey of the project indicates that 33 percent farmers are either composting the pseudostem or chopping and incorporating it into the fields while rests two-third farmers are disposing it either on field bunds or in nallas. Not a single farmer was found to develop any value added products from it. With this perspective, the project entitled, "A Value Chain on Utilization of Banana Pseudostem for Fibre and Other Value Added Products" was sanctioned by NAIP on 29 May 2008 to examine prospects using banana pseudostem fibre as supplemental raw material for textile and paper industries with the overall objectives of 1) Standardize processes for extracting textile grade fibres from pseudostem and prepare home furnishings; 2) Standardize processes of pulp and paper making from pseudostem, fibres and scutching waste both at hand made and industrial levels; 3) Develop value added edible products from central core; 4) Preparation and evaluation of enriched sap and scutching waste based vermicompost; and 5) Develop linkage for marketing of pseudostem based products. The consortium consists of NAU, Navsari as lead centre and CIRCOT (ICAR), Mumbai, MANTRA, Surat and JK Paper Ltd., Songadh as partners. In this project, fibre extraction is done by raspador machine, a highly efficient with low operating and maintenance cost, developed by CIRCOT, Mumbai with some modifications to suite farmers' fields conditions. For speedy splitting of pseudostem a cutter machine has been developed by NAU, Navsari which facilitates easy separation of sheaths. Fabrication and development of machineries for



yarn preparation have been done, and refinement towards improvement in quality of yarn is in progress. Considering the present quality of yarn and fabric, it can be used in technical textile where huge market potential is available. Under this project, so far about 41.6 tonnes dry fibre has been extracted from pseudostem (farmers + university) and used for preparing yarn (2.6 t) on jute spinning system, woven fabric (350 m). Apart from fabrics, banana fibre was utilized for preparing paper both at handmade scale and quality papers. Apart from quality testing done at JK Paper, the paper samples were also tested at CIRCOT, Mumbai and PAPRI, Orissa. Scutching waste has been used for preparing vermicompost. The process for preparing has been standardized at NAU, Navsari and the ratio of 70: 30 (scutching waste: cow dung) was found to be ideal from nutrient point of view. NAU and CIRCOT have been developing technologies for using sap in a profitable way. Sap can be used directly or through organic enrichment as liquid fertilizer or nutrient spray. A farmers growing banana can realize an additional income of Rs. 60,000 to 70,000 per ha from fibre, sap and vermicompost preparation on annual basis.

Oral presentations

1. *Development of high rate bioreactor for energy conversion of waste coconut water*: Dr. Shaji James
2. *Labour-friendly and energy efficient new design drier for processing of sheet rubber*: Dr. Mathew Joseph
3. *In vitro antioxidant and cytotoxic activities of selected Piper species and black pepper varieties*: Ms. D Sruthi

Major recommendations

1. The cost economics of the coconut shell reactor may be worked out and the technology extended to the stake holders.
2. The effect of combined extracts from selected *Piper* species of black pepper on cytotoxicity may be investigated.
3. Awareness may be created among farmers groups on adherence of globalized quality standards in order to enhance income and profitability.



SESSION V
KNOWLEDGE MANAGEMENT: EXTENSION
11 December 2014

The session was chaired by Dr. S. Arul Raj, Director, ICAR-Indian Institute of Oil Palm Research, Pedavegi and Shri. Sugata Ghose, Chief Coconut Development Officer, Coconut Development Board, Kochi. Dr. S. Kalavathi, Principal Scientist, ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam and Dr. Lijo Thomas, Scientist, ICAR-Indian Institute of Spices Research, Kozhikode were the rapporteurs. Two lead lectures, 3 oral and 23 posters were presented in this session.

Lead lectures

1. *Productivity improvement of pepper: A challenge for the traditional producing countries*: Dr. W. D. L. Gunaratne, Executive Director, International Pepper Community, Jakarta, Indonesia.

Abstract: Productivity of pepper in major traditional pepper producers except, Malaysia is far below the newly emerging pepper producers and even in Malaysia, total production shows a decline. Low unit area production of pepper is associated with many factors. Extent of vacancies in a pepper plantation, poor pepper canopy development due to less number of lateral branches and their weak growth and low height, (low productive area in canopy), excess shade from support or neighboring trees, poor soil productivity management leading to inadequate nutrient supply, low moisture retention and poor drainage and low microbial activity as well as pests & diseases incidences are some of them. Traditional pepper producing countries like India, Indonesia and Sri Lanka mainly confined to small pepper cultivations mostly associated with mixed home garden systems. Until recent past pepper was not considered as a plantation agriculture crop but a side income for the grower. Fast growth of the pepper industry in new producing countries is mainly due to their organized cultivation system leads to higher productivity in term of per unit area production and assured quality of the end product. Use of comparatively new lands, use of better quality planting material, adoption of better cultural practices and



train the pepper vines on dead support are major reason for higher productivity. While live supports are used, keeping support tree pruned frequently to minimize the competition from above ground canopy for sunlight as well as to minimize the completion for soil resources and increase the height of support beyond 6 meters with well-formed canopy structure produce more spikes. Adequate application of chemical and organic fertilizer as well as control of disease and pest incidences with close attention are the other reasons behind them. With all those, well organized government as well as private support system is readily available for the producer to move with confidence.

2. *Plantation and spices based agro eco tourism*: Dr V. S. Korikanthimath, Former Director, ICAR-Central Coastal Agricultural Research Institute, Goa.

Abstract: In 2014, India has emerged as a major producer of horticulture crops (269 million tonnes, surpassing food grain production of 265 million tonnes). Plantation and spice crops are high value commercial crops of greater economic importance and export potentiality. Tea, coffee, rubber, cashew, coconut, arecanut, oil palm and cocoa play vital role in improving Indian economy and generation of gainful employment. India (home of spices) with more than 50 spices is the largest producer, consumer and exporter of spices in the world. This paper includes- types of tourism, objectives, principles, components and scope of agro-eco-tourism besides information on eco-tourism centres, sights, technology parks, entrepreneurship, benefits to stake holders, socio-economic prospects, marketing strategies role of agricultural institutes and NGOs in promoting eco-tourism in India. The issues which need attention for promotion of agro-eco-tourism are also highlighted. Home stays have been attracting a large number of tourists in plantation (coffee) and spices (cardamom, pepper, ginger etc) gardens in Coorg, Karnataka and elsewhere in India. Even in state like Goa which has carved a niche as an International renowned tourism destination, there is a paradigm shift from "on shore tourism to off share (hinterland) tourism". Different components involved in promoting plantation and spices based agro-eco-tourism in Goa and other parts of India which have been attracting a large number of tourists are presented and discussed in detail for successful implementation of agro-eco-tourism programmes.

Oral presentations

1. *Use of farmer's portal for dissemination of oil palm technology in India*: Dr. K. L. Mary Rani.

2. *Plantation crops sector in India: Need of a restructured innovation system for inclusive growth in the context of trade reforms*: Dr. S. Jayasekhar.

3. *Strategic approaches in NR Sector to ensure technology adoption through setting up RAMU – a knowledge management model*: Dr. B. Rajeevan.



Major recommendations

1. The professionals engaged in transfer of technology should explore the advances in communication, data management and delivery mechanism to evolve suitable models for technology dissemination.

2. The policy environment need to be revamped to support greater innovation by considering suggestions on sectoral policy decisions of scientific bodies and academic institutions to strengthen small holder orientation and sustainability of production systems in plantation crops sector.



PLENARY SESSION

11 December 2014

The plenary session was chaired by Dr. M. Anandaraj, General Chairman, PLACROSYM XXI. Dr. C. M. Senthil Kumar, Senior Scientist, ICAR-Indian Institute of Spices Research, Kozhikode and Dr. R. Praveena, Scientist, ICAR-Indian Institute of Spices Research, Kozhikode were the rapporteurs.

Dr. Santhosh J. Eapen presented the summary of major recommendations

1. Genomics based molecular markers for quantitative traits like height, yield and disease resistance should be employed in plantation crops breeding.
2. The germplasm passport and characterization data available on plantation crops may be made available in the public domain through a joint initiative of all the stakeholders.
3. Inter cropping bio-fortified crops, medicinal and aromatic plants in plantation crops have to be promoted for the livelihood and nutritional security of farmers.
4. The potential of chemical ecology may be exploited for management of insect pests prevalent in multi-species cropping systems.
5. Research on gender friendly machineries that are suitable for smallholdings needs to be intensified for mechanization in plantation sector.
6. The feasibility of adopting the banana value chain model in Maharashtra may be explored in plantation crops.
7. Farmer Producer Organizations (FPO) or companies (FPC) or Joint Liability Groups (JLG) need to be promoted for inclusive development of plantation sector.
8. More awareness among farmer groups may be created on adherence of globalized quality standards in order to enhance more income and profitability.
9. Farmer-farmer learning has to be promoted through farm schools, cluster based groups similar to RPSs by all stakeholders.
10. The funding offered by ITRA may be availed by all for delivery of proactive actionable agriculture advice to poor and marginal farmers.
11. Need for inter-institutional collaboration with respect to climate change in plantation crops especially pest and disease problems.



12. Need to develop capabilities for economic intelligence by institutes working in plantation crops.

This was followed by the comments from the standing committee members. Dr. Y. Raghuramalu, emphasized the need for inter-institutional collaboration with respect to climate change in plantation crops. Dr. P. Rethinam stressed that ISPC may form a small working group to work towards common pest and diseases of plantation crops. He also mentioned that the nursery situation in plantation crops needs to be streamlined for all plantation crops. Further, he expressed concern about inadequate work on post harvest handling and mechanization in these crops. Dr. S. Arul Raj emphasized the need to develop capabilities for economic intelligence by institutes working in plantation crops. Dr. B. Radhakrishnan, stressed the need for studies in development of resistance in plantation crop pests against insecticides and also developing spraying techniques for plantation crops. Dr. K. Nirmal Babu, emphasized the need for developing appropriate varieties for specific regions suiting the needs of industries and stressed the importance of GAPs for containing residues in spices. The awards for the best oral and posters were announced by Dr. S. Devasahayam. This was followed by feedback from participants. Dr. N. M. Nair suggested that India should lead in publications related to plantation crops in international journals. He also suggested that young scientists should improve their communication skills to publish their papers in reputed International journals and recommended exposure visits for Indian scientists abroad to tone their skills with latest improvements. The venue for holding the 22nd PLACROSYM was decided as ICAR-CPCRI, Kasaragod and CCRI, Balehonnur has agreed to hold the 23rd PLACROSYM.

Dr. M. Anandaraj in his concluding remarks advised youngsters to take up work on cutting edge research and to translate technologies to field level adaptation. He also emphasized the need for water harvesting structures in dry areas by consolidating the resources of farmers and envisioned that next PLACROSYM should be a competitive platform for entrepreneurs to buy technologies. Dr. T John Zachariah, Co-General Convenor, proposed the vote of thanks and the meeting was formally closed by the Chairman.



AWARDS

Dr. C. S. Venkataram Memorial Best Oral Presentation Award: Defence system against white stem borer discovered in coffee: **H L Sreenath**

Dr. R. L. Narasimha Swamy Memorial Second Best Oral Presentation Award: Soil related constraints to plantation crop production in Kerala: **K M Nair, K S Anil Kumar, S Thayalan & S K Singh**

Dr. R. L. Narasimha Swamy Memorial Best Poster Award: Capsule gradation in large cardamom: **T N Deka, A K Vijayan, B A Gudade & P Chhetri**

Dr. G. Venkateswaran Best Poster Award for Varietal Wealth Session: Integration and expression of *hmgr1* gene in the transgenic plants of *Hevea brasiliensis* (clone RRII 105): **R Jayashree**

ISPC & PLACROSYM XXI Best Poster Award for Production Systems Session: Studies on different mulches used to alleviate summer stress in young rubber plants: **Sherin George, Sabu P Idicula & Kochutresiamma Joseph**

Dr. Muthuswamy Anandaraj Best Poster Award in Plant Health Management Session: Biodiversity and community analysis of nematodes associated with black pepper rhizosphere from Idukki District (Kerala), India: **Rashid Pervez, Santhosh J Eapen, T K Jacob, S Hamza & V Srinivasan**

Dr. D. Jaganathan Best Poster Award for Knowledge Management Session: Impact study on area wide extension approach for bio management of rhinoceros beetle in farmers' fields: **P Anithakumari, K Muralidharan, Thejaswibhai & Chandrika Mohan**



ORGANIZING COMMITTEE

Chief Patron

Dr. S. Ayyappan, Director General, Indian Council of Agricultural Research, & Secretary, Department of Agricultural Research and Education, New Delhi

Patron

Dr. N. K. Krishna Kumar, Deputy Director General (Horticulture Science), Indian Council of Agricultural Research, New Delhi

General Chairman

Dr. M. Anandaraj, Director, ICAR-Indian Institute of Spices Research, Kozhikode, Kerala

General Convener

Dr. S. Devasahayam, Head, Crop Protection, ICAR-Indian Institute of Spices Research, Kozhikode, Kerala

Co-Convenor

Dr. T. John Zachariah, Head, Crop Production and Post Harvest Technology, ICAR-Indian Institute of Spices Research, Kozhikode, Kerala

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2. Dr. P .K. Vinod Kumar, Central Coffee Research Institute, Balehonnur, Karnataka
3. Dr. P. Chowdappa, ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala
4. Mr. Sugata Ghose, Coconut Development Board, Kochi, Kerala
5. Prof. P.L. Saroj, ICAR-Directorate of Cashew Research, Puttur, Karnataka
6. Dr. S. Arul Raj, ICAR-Directorate of Oil Palm Research, Pedavegi, Andhra Pradesh
7. Dr. Y. S. Rao, Indian Cardamom Research Institute, Kochi, Kerala
8. Dr. James Jacob, Rubber Research Institute of India, Kottayam, Kerala



9. Dr. N. Muraleedharan, Tea Research Association, Jorhat, Assam
10. Dr. B. Radhakrishnan, UPASI Tea Research Foundation, Coimbatore, Tamil Nadu
11. Dr. M. Anandaraj, Indian Society for Plantation Crops, Kasaragod, Kerala
12. Dr. K. Nirmal Babu, Indian Society for Spices, Kozhikode, Kerala
13. Dr. P. Rethinam, SOPORAD, Pedavegi, Andhra Pradesh

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12. Dr. D. Prasath, Indian Society for Spices, Kozhikode, Kerala
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Dr. T. John Zachariah
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Dr. S. J. Ankegowda

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Members	:	Dr C. M. Senthil Kumar, Dr R. Ramakrishnan Nair

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Co-convener	:	Dr. Rashid Pervez
Member	:	Mr. K. Jayarajan, Mr. A. Sudhakaran

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Members	:	Dr. E. Jayashree, Dr. R. Praveena, Ms. S. Aarthi



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Member	:	Mr. R. N. Subramanaian

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Convener	:	Dr. B. Sasikumar
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Members	:	Dr. S. J. Ankegowda, Mr. M. Radhakrishnan

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Convener	:	Mr. K. V. Pillai
Co-Convener	:	Ms. P. V. Sali
Member	:	Ms. Shyna Deepesh



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2.	Dr. N K Krishna Kumar	Deputy Director General (Hort. Science) Indian Council of Agricultural Research, New Delhi-110 001
3.	Prof. K V Peter	Former Director (ICAR-IISR, Kozhikode) & Chairman World Noni Research Foundation, Perungudi, Chennai-600096, Tamil Nadu
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6.	Dr. K Prathapan	Mission Director State Horticulture Mission, Thiruvananthapuram-695 034, Kerala
7.	Dr. Homey Cheriyan	Director Directorate of Arecanut & Spices Development, Kozhikode-673 005, Kerala
8.	Dr. P L Saroj	Director ICAR-Directorate of Cashew Research, Puttur-574 202, Karnataka



9.	Dr. J Thomas	Director Indian Cardamom Research Institute, Myladumpara-685 553, Idukki, Kerala
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22.	Dr. S Edison	Former Project Coordinator, AICRPS, ICAR-Indian Institute of Spices Research, Kozhikode-673 012, Kerala
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2.	Dr. M K V Carr	Emeritus Professor Agricultural Water Management, Cranfield University, UK
3.	Dr. M Anandaraj	Director, ICAR-Indian Institute of Spices Research, Kozhikode- 673 012, Kerala
4.	Dr. Shannon Olsson	Reader, Naturalist-Inspired Chemical Ecology, National Center for Biological Sciences, Tata Institute of Fundamental Research, Bengaluru-560 065, Karnataka



5.	Dr. W D L Gunaratne	Executive Director International Pepper Community, Jakarta, Indonesia
6.	Mr. Santosh Kumar	Vice President (Rubber) Harrisons Malayalam Ltd., Kochi-682 003, Kerala
7.	Dr. D Venkateswaran	Director Ulavan Producer Company Ltd., 8, Erode-638 003, Tamil Nadu
9.	Mr. J N Jagathbhushan	Planter Blue Moon Estate, Bandhalli-585 202, Karnataka
10.	Dr. P Krishna Reddy	Professor International Institute of Information Technology, Hyderabad-500 032, Telangana

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42.	Dr. D Balasubramanian	Principal Scientist ICAR-Directorate of Cashew Research, Puttur-574 202, Karnataka
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262.	Dr. U Surendran	Scientist Centre for Water Resources Development & Management, Kozhikode-673 571, Kerala
263.	Dr. C Krishnamoorthy	Assistant Professor Vanavarayar Institute of Agriculture, Pollachi-642 103, Tamil Nadu
264.	Dr. K K Sabu	Scientist Jawaharlal Nehru Tropical Botanic Garden & Research Institute, Thiruvananthapurâm-695 562, Kerala
265.	Dr. Anupam Pariari	Associate Professor Bidhan Chandra Krishi Viswavidyalaya, Nadia-741 252, West Bengal
266.	Mr. Siddalingayya Salimath	Ph.D. Student University of Horticultural Sciences, Bagalkot-587 120, Karnataka
267.	Dr. N Aswathanarayana Reddy	Assistant Professor Horticulture Research & Extension Centre, Hogalagere-563 138, Karnataka
268.	Dr. M K Honnabyraiah	Associate Director (Research & Extension) Horticulture Research & Extension Centre, Hogalagere-38, Karnataka
269.	Dr. T B Basavaraju	Professor (Agronomy) UHS-Horticulture Research Station, Arsikere-573 103, Karnataka



270.	Dr. K M Indiresh	Dean College of Horticulture, Mudigere-577 132, Karnataka
271.	Dr. Nagarajappa Adivappar	SMS (Hort.) Krishi Vigyan Kendra, Shimoga-577 204, Karnataka
272.	Mr. H B Narasimhamurthy	Student UAHS, Shimoga-577 205, Karnataka
273.	Ms. D M Soumya	Student UAHS, Shimoga-577 205, Karnataka
274.	Dr. H Ravindra	Professor Zonal Agricultural & Horticultural Research Station, Shimoga-577 204, Karnataka
275.	Dr. K Sethi	Assistant Professor Orissa University of Agriculture & Technology, Bhubaneswar-751 003, Odisha
276.	Dr. Pradyumna Tripathy	Associate Professor Orissa University of Agriculture & Technology, Bhubaneswar-751 003, Odisha
277.	Dr. N B V Chalapathi Rao	Senior Scientist Horticultural Research Station, Dr. YSRHU, Ambajipeta-533 214, Andhra Pradesh
278.	Dr. G Ramanandam	Principal Scientist Horticultural Research Station, Dr. YSRHU, Ambajipeta-533 214, Andhra Pradesh
279.	Dr. A Snehalatha Rani	Scientist Horticultural Research Station, Dr. YSRHU, Ambajipeta-533 214, Andhra Pradesh



280.	Dr. G N Murthy	Scientist (Hort) Horticultural Research Station, Dr. YSRHU, Pandirimamidi-533 288, Andhra Pradesh
281.	Dr. Ivan Aranha	Assistant Professor (Zoology) Ahmednagar College, Station Road, Ahmednagar-414 001, Maharashtra
282.	Dr. R G Khandekar	Agronomist Regional Coconut Research Station, Bhatye-415 612, Maharashtra
283.	Dr. Sawant Vishal	Professor Regional Coconut Research Station, Ratnagiri-415 612, Maharashtra
284.	Mr. Siddhesh P Salvi	Student Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli-415 612, Maharashtra
285.	Dr. N Sathi Babu	Ph.D. Student Uttar Benga Krishi Viswavidyalaya, Pundibari-736 165, West Bengal
286.	Dr. Anjali Prasad	Research Scholar University of North Bengal, Siliguri-734 013, West Bengal
287.	Dr. Deeki Lama Tamang	Student Sikkim University, Gangtok-737 102, Sikkim
288.	Dr. M Balasubramanian	Associate Professor KSR College of Technology, Thiruchengode-637 215, Tamil Nadu
289.	Dr. Minoo Divakaran	Assistant Professor Providence Women's College Kozhikode-673 009, Kerala



290.	Dr. K U K Nampoothiri	Director MS Swaminathan Research Foundation, RC, Jeypore-764 001, Odisha
291.	Dr. V V Radhakrishnan	Associate Professor University of Calicut, Malappuram-673 635, Kerala
292.	Dr. Sachin P James	Assistant Professor (Zoology) Malabar Christian College, Kozhikode-673 001, Kerala
293.	Dr. D Shalini	Assistant Professor SNS College of Engineering, Coimbatore-641 107, Tamil Nadu
294.	Mr. J Ebenezer Samuel King	Student KSR College of Technology, Thiruchengode-637 215, Tamil Nadu
295.	Ms. Silpa Mohan	Student Mar Athnasious College for Advanced Studies, Thiruvalla-689 101, Kerala
296.	Ms. P Aiswariya	Student St. Mary's College for Women, Thiruvalla-689 101, Kerala
297.	Ms. P Linsi	Student St. Mary's College for Women, Thiruvalla-689 101, Kerala
298.	Ms. P V Suvina	Student St. Mary's College for Women, Thiruvalla-689 101, Kerala
299.	Dr. Nirmala Kannan	Retd. HoD Central Coffee Research Institute, Chikmagalur-577 112, Karnataka
300.	Mr. V Unnikrishnan	General Manager AV Thomas Group Companies, Kochi- 682 036, Kerala



301.	Dr. K Divakaran	Assistant Manager Kanan Devan Hills Plantations Co. (P) Ltd., Munnar-685 612, Kerala
302.	Dr. K Perumalsamy	Assistant Manager Kanan Devan Hills Plantation Co. (P) Ltd., Munnar-685 612, Kerala
303.	Dr. Siby Mathew	Senior Manager Kannan Devan Hills Plantations Co. (P) Ltd., Munnar-685 612, Kerala
304.	Dr. K Ajayakumar	Senior Manager Harrisons Malayalam Plantations Ltd., Kochi- 682 003, Kerala
305.	Mr. Ashok Jevoor	Director IMT Technologies Ltd., IMT Ranadey Group, Pune-411 048, Maharashtra
306.	Mr. Dinesh Verma	Technical Director IMT Technologies Ltd., IMT Ranadey Group, Pune-411 048, Maharashtra
307.	Mr. M A Bhashyam	Southern Phosphate & Mineral, Kochi-682 019, Kerala
308.	Dr. S Marimuthu	Head (R & D Centre) Parry Agro Industries Ltd., Murugalli Estate, Valparai-642 125, Tamil Nadu
309.	Dr. Abraham Jacob	Director POABS Estates Pvt. Ltd., Thiruvalla-689 106, Kerala
310.	Dr. Siljo Abraham	Scientist POABS Biotech (P) Ltd., Seethargund, Palakkad-678 508, Kerala
311.	Dr. Dilip Nagwekar	Ex-Agronomist Regional Coconut Research Station, Bhatye-415 612, Maharashtra



312.	Mr. Mahesh Kanumury	Nualgi Nanobiotech, Jayanagar, Bengaluru-560 041, Karnataka
313.	Mr. T Sampath Kumar	CEO Nualgi Nanobiotech, Jayanagar, Bengaluru-560 041, Karnataka
314.	Mr. Bopanna Belliappa	Planter Luckery Estate, Madapur- 571 251, Kodagu, Karanataka
315.	Mr. Apana P Subaiya	Planter Nakoor Bledfa Estate, Sunticoppa- 571 237, Karanataka
316.	Mr. Arun Bhave	General Manager Joonktollee Tea & Ind. Ltd., Somwarpet- 571 236, Karanataka
317.	Mr. PK Ahmed Kutty	Farmer Tropical Farm, Kozhikode-673 001, Kerala
318.	Mr. P K Asif	Farmer PK Plantations, Malappuram-673 602, Kerala
319.	Mr. David J Lobo	Representative Deejay Group, Brigade Road, Bengaluru-560 025
320.	Mr. V Dwarakanathan	Planter Nagaramalai, Adivaram Reddiyur Village, Salem-636 016, Tamil Nadu
321.	Mr. P Haridas	Consultant (Tea, Pepper) Thykkat Pannikot House, Thruvali-676 123, Malappuram, Kerala
322.	Mr. T Hariharan	Consultant (Natural Rubber Cultivation) 20 - Samarasa Veethi Kottar, Nagercoil-629 002, Tamil Nadu



323.	Mr. C F Jacob	Farmer No. 73, 9th Main, 4th C Block, Koramangala, Bengaluru-560 034, Karnataka
324.	Mr. T Kuruvilla	Farmer Rose Garden Estate, Meppadi, Wayanad-673 577, Kerala
325.	Mr. S S Mehta	Proprietor Brooklands Estate, Salem-636 016, Tamil Nadu
326.	Mr. R Muralidharan	Manager -SBU (B) Harrisons Malayalam Plantations Ltd., Kochi- 682 003, Kerala
327.	Mr. R Padmanaban	Private Consultant 17/22, Titan TownShip, Mathigiri, Hosur-635 110, Karnataka
328.	Mr. A C Periyakaruppan	Executive Ponni Plantations, Koppa-577 126, Karnataka
329.	Mr. Prakashan R S Balaraman	Planter 374/547, Trichy Main Road, Gugai, Salem-636 006, Tamil Nadu
330.	Mr. T Raju	Planter Flat No. 201, 3rd Block CTD -CHS Enclave, Vallalar Nagar, Coimbatore-641 016, Tamil Nadu
331.	Mr. H Y Ramaiah	Farmer 124, 42nd Cross, 8th Block, Jayanagar, Bengaluru-560 070, Karnataka
332.	Mr. P K Ramesh	Plantation Consultant Plantation Services, PB No. 173, Chikmagalur-577 101, Karnataka
333.	Mr. P R Rathnam	Managing Director The Savamalai Estates Ltd., Coimbatore-641 011, Tamil Nadu



334.	Mr. K Roshan	Farmer Kynadi Plantations, Kozhikode-673 573, Kerala
335.	Mr. C N Sathyendran	Planter 2, Park Street, Fairlands, Salem-636 016, Tamil Nadu
336.	Mr. V S Sharma	Technical Advisor The BBTC Ltd., Coimbatore-642 117, Tamil Nadu
337.	Mr. M Sibichan Chacko	Senior Manager Thirumbadi Rubber Co. Ltd., Mukkam, Kozhikode-673 602, Kerala
338.	Mr. O V R Somasundaram	Farmer OVR Farms, Odayakulam, Pollachi, Coimbatore- 642 129, Tamil Nadu
339.	Mr. M S Sreenivasan	Plantation Consultant & Valuer for Banks Kudregundi Estate, Mudigere- 577 132, Karnataka
340.	Mr. N Subramaniam	Planter Anusha Plantations, Salem-636 007, Tamil Nadu
341.	Mr. C N Sivadasan	Member Karshaka Sanga, Kozhikode, Kerala
342.	Mr. Vinodkumar Damodar	Member Karshaka Sanga, Kozhikode, Kerala
343.	Mr. V Vijaya Kumar	Floriculturist Kozhikode, Kerala
344.	Mr. B K Rajan Nair	NIRAVU, Farmers Association, Vengeri, Kozhikode, Kerala
345.	Mr. Ajish Antony	Ariyappillil (H), Karamana, Kerala

Glimpses of PLACROSYM XXI

INAUGURAL SESSION

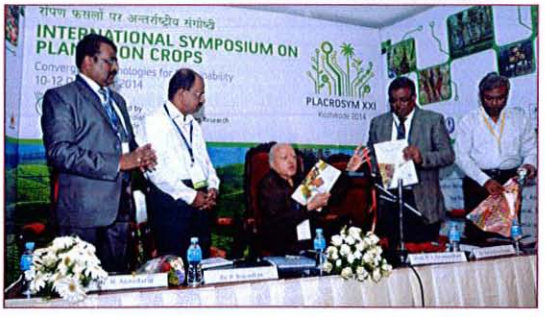
Dr M Anandaraj, Director, ICAR-IISR, Kozhikode and General Chairman, PLACROSYM XXI delivering the Welcome Address

Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai lighting the lamp during the inauguration of PLACROSYM XXI

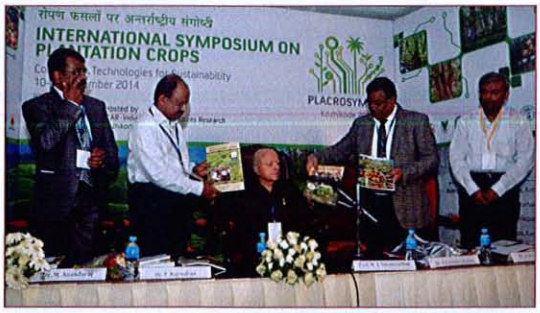
Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai delivering the Inaugural Address

Dr. N. K. Krishna Kumar, DDG (Hort.), ICAR, New Delhi delivering the Key Note Address

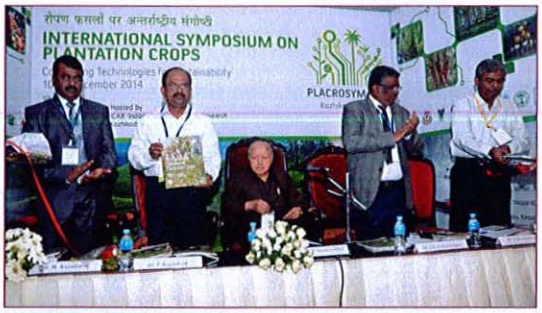
Dr. P. Rajendran, Vice Chancellor, Kerala Agricultural University, Trichur, delivering the Presidential Address



Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai releasing the *Abstract of Papers* and *Souvenir*



Dr. N. K. Krishna Kumar, DDG (Hort.), ICAR, New Delhi releasing the special issues of *Indian Horticulture, Spice India* and *Journal of Arecanut, Spices and Medicinal Plants*



Dr. P. Rajendran, Vice Chancellor, Kerala Agricultural University, Trichur, releasing the book on *Phytophthora Diseases of Plantation Crops*

Dr. S. Devasahayam, Head, Division of Crop Protection, ICAR-IISR, Kozhikode and General Convener, PLACROSYM XXI proposing the Vote of Thanks

AWARDS PRESENTATION DURING INAUGURAL SESSION

Dr. M. Anandaraj, Director, ICAR-IISR receiving the Dr. C. S. Venkataraman Memorial Trust Award for Distinguished Plantation Crops Scientist from Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai

Dr. K. Nirmal Babu, Project Coordinator (AICRPS) receiving the Dr. C. S. Venkataraman Memorial Trust Award for Distinguished Plantation Crops Scientist from Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai

Dr. Molly Thomas receiving the Best Research Paper Award of JPC from Dr. P. Rajendran, Vice Chancellor, KAU

Dr. Anita Karun, ICAR-CPCRI, Kasaragod, Kerala receiving the Supari Federation Award for Best Scientist from Dr. N. K. Krishna Kumar, DDG (Hort.), ICAR, New Delhi

Mr. B. A. Narayana receiving the Supari Federation Award for best arecanut farmer from Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai

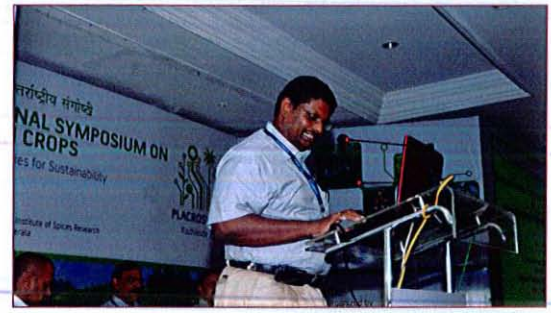
Mr. J. N. Jagath Bhusan receiving the Mehta Foundation Award for best innovative farmer from Prof. M. S. Swaminathan, Founder Chairman and Chief Mentor, MSSRF, Chennai

Dr. Santhosh J Eapen, ICAR-IISR receiving the PLACROSYM Logo Award from Dr. M. Anandaraj, Director, ICAR-IISR, Kozhikode

LEAD LECTURES

Breeding strategies in perennial crops with special reference to oil palm: Dr. N. Rajanaidu, Malaysian Palm Oil Board, Selangor, Malaysia.

Role of farmer producer companies in marketing of agricultural produces: Dr. D. Venkateswaran, Director, Ulavan Producer Company Ltd. Erode



Natural rubber industry-present crisis, concerns and future directions: Mr. Santhosh Kumar, Vice President (Rubber), Harrison Malayalam Limited, Kochi

Cultivation of coffee without shade: Mr. J. N. Jagath Bhushan, Planter, Blue Moon Estate, Bandhalli, Hassan District, Karnataka

Tea Research: Is it sustainable? (Or is sustainability unsustainable): Dr. M. K. V. Carr, Professor Emeritus, Agricultural Water Management, Cranefield University, Bedfordshire, UK

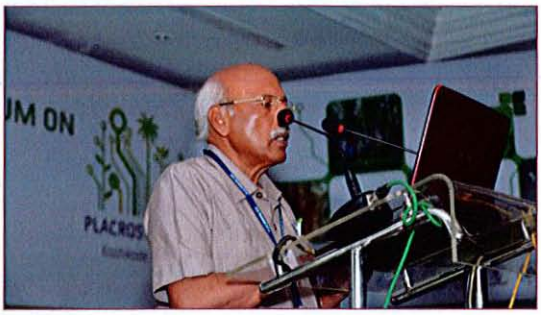
Phytophthora: A global pathogen: Dr. M Anandaraj, Director, ICAR-Indian Institute of Spices Research Kozhikode

Naturalist inspired chemical ecology: Dr. Shannon Olsson, Reader, National Centre for Biological Sciences, Tata Institute of Fundamental Research, Bengaluru

eKisanSaathi: Delivering pro-active actionable agricultural advice to poor and marginal farmers: Dr. P Krishna Reddy, Professor, International Institute of Information Technology, Hyderabad

A value chain on utilization of banana pseudostem for fibre and other value added products: Dr. P. Rethinam, Former Executive Director, APCC, Jakarta

Productivity improvement of pepper: A challenge for the traditional producing countries: Dr. W. D. L. Gunaratne, Executive Director, International Pepper Community, Jakarta, Indonesia.



Plantation and spices based agro eco tourism: Dr V. S. Korikanthimath, Former Director, ICAR-Central Coastal Agricultural Research Institute, Goa

AWARDS PRESENTED DURING PLENARY SESSION

Dr. C. S. Venkataram Memorial Best Oral Presentation Award: Defence system against white stem borer discovered in coffee: H L Sreenath

Dr. R. L. Narasimha Swamy Memorial Second Best Oral Presentation Award: Soil related constraints to plantation crop production in Kerala: K M Nair, K S Anil Kumar, S Thayalan & S K Singh

Dr. R. L. Narasimha Swamy Memorial Best Poster Award: Capsule gradation in large cardamom: T N Deka, A K Vijayan, B A Gudade & P Chhetri

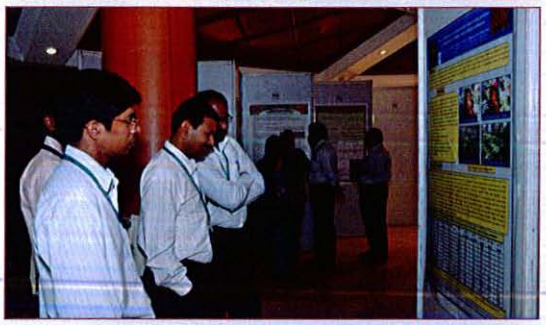
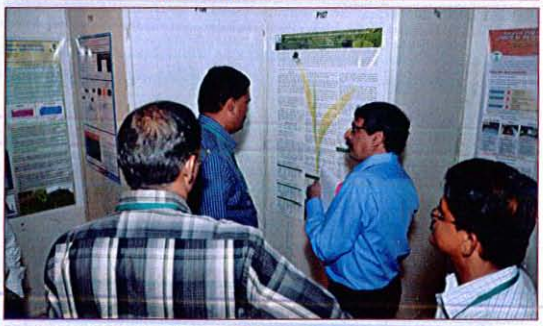
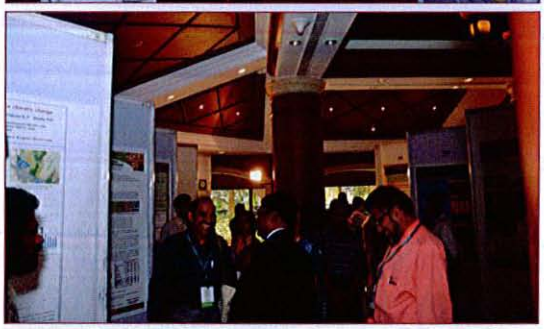
Dr. G. Venkateswaran Best Poster Award for Varietal Wealth Session: Integration and expression of *hmgr1* gene in the transgenic plants of *Hevea brasiliensis* (clone RRII 105): R Jayashree

ISPC & PLACROSYM XXI Best Poster Award for Production Systems Session: Studies on different mulches used to alleviate summer stress in young rubber plants: Sherin George, Sabu P Idicula & Kochutresiamma Joseph

Dr. Muthuswamy Anandaraj Best Poster Award in Plant Health Management Session: Biodiversity and community analysis of nematodes associated with black pepper rhizosphere from Idukki District (Kerala), India: Rashid Pervez, Santhosh J Eapen, T K Jacob, S Hamza & V Srinivasan

Dr. D. Jaganathan Best Poster Award for Knowledge Management Session: Impact study on area wide extension approach for bio management of rhinoceros beetle in farmers' fields: P Anithakumari, K Muralidharan, Thejaswibhai & Chandrika Mohan

POSTER PRESENTATIONS




EXHIBITION STALLS






PLACROSYM XXI

Kozhikode 2014

10-12 December 2014, Kozhikode, Kerala, India

ICAR-Indian Institute of Spices Research
(An ISO 9001:2008 Certified Organization)
(Indian Council of Agricultural Research)
Kozhikode - 673 012, Kerala, India