



Vol. XVIII / No. 1 & 2

April, 2013 - March, 2014

## FROM THE DIRECTOR'S DESK



Bananas and plantains are continuously exhibiting a spectacular growth worldwide. In India, there has been a significant increase in terms of area, production and productivity in the last two decades. Wild species of *Musa acuminata* from Baramurah hills and Behula and Batheeshwar from Nagicherra were added to the *in-vitro* genebank. NRCB has developed low cost tissue culture protocols for mass multiplication of commercial varieties *viz.*, Udhayam, Rasthali and Grand Naine. Sigatoka leaf spot disease resistant gene from cv. Manoranjitham and two nematode resistance gene(s) in banana were identified and characterized. The fertilizer adjustment equations developed and validated at banana growing areas indicated its effectiveness. In cv. Udhayam, application of N and K<sub>2</sub>O in the ratio of 7:2:1 and 4:3:3 at vegetative, flowering and bunch development stages recorded early fruit maturity and highest bunch weight. This year 35464 mother culture TC plants were tested for virus indexing

and genetic fidelity. The improved postharvest handling techniques were developed for cv. Udhayam banana, Rasthali (cv. Mortman). Survey conducted in the major banana growing areas of Assam has resulted in the identification of new isolate of *Beauveria bassiana* and small banana weevil.

Farmers from different banana growing areas are trained in technologies relating to banana production, protection and value addition. NRCB organized its 20<sup>th</sup> Foundation day as "Banana Kissan Mela" with the theme on "Banana fruit care" for benefit of the farmers. During the period, participated in the ten exhibitions to disseminate the technologies developed at Centre to the various stake holders. Participated in four 'Banana Festival' organized in collaboration with Confederation of Indian Industries (CII) Tamil Nadu chapter and Tamil Nadu Banana growers' Federation to motivate the farmers in banana cultivation. A farmer, Shri G. Loganathan has created a world record in banana production by harvesting 165 tons/ha in K.K. Patti by adopting the improved production technologies developed by NRC Banana.

## RESEARCH ACHIEVEMENTS

### A dwarf banana (NRCB selection - 10) identified and evaluated

A dwarf banana (NRCB Selection-10) similar to Karpuravalli (ABB) was identified and its performance was studied. The results indicated its superiority for dwarf stature and earliness. The selection -10 has the potential to produce 18-20 kg bunch with 12-13 hands and average 16 fruits per



Bunch of NRCB selection 10

## CONTENTS

Research Achievements	1
Transfer of Technology	3
Linkages and Collaborations	4
Publications	5
Consultancy Services and Commercialization of Technologies	5
RAC/ IMC/ IRC Meetings	6
Training / Refresher Courses Attended by the Scientists (HRD)	6
Other Informations	7

hand and harvested in an average of 367 days. The average plant height of 2.30-2.60m indicated its potential under high density planting and earliness for adaption under annual cropping system.

### **Musa chitinase gene for the control of nematodes**

The purified *Musa* chitinase tested against nematode eggs indicated chitinase treated eggs did not hatch and all the treated eggs exhibited one or the other abnormalities and eggs failed to hatch. This suggested that chitinase could be one of the factors imparting resistance against nematodes.

### **Use of low cost media alternatives in banana tissue culture**

Tissue culture protocols with low cost media alternatives like sago / isabgol as culture medium have been developed for three commercial varieties of banana viz., Udhayam, Rasthali and Grand Naine. The low cost medium was found to be 20 times cheaper than the normal medium.

### **Biocontrol agents and botanicals for the suppression of Fusarium wilt disease in cv. Rasthali (Mortman)**

Different bio-control agents were field evaluated for the suppression of Fusarium wilt disease in cv. Rasthali. Maximum reduction of Fusarium wilt disease (disease score 2 in the 1 - 6 disease scale) was recorded in the banana corm treated with endophytic *T. harzianum*, Endo *P. pinophilum*, wild *P. pinophilum* + rhizo *T. asperellum*, endo. mut. *P. pinophilum* + rhizo. Mut. *T. asperellum*, endo *P. putida*+ rhizo *Bacillus* spp., endo. mut. *Penicillium* spp. + rhizo. Mut. *T. asperellum*, *Trichoderma* sp. SrT3, *Trichoderma* sp. Kr2, Endo *T. harzianum* + rhizo. Mut *T. longibrachiatum* + Difenoconazole (0.1%). The percentage of plants sustained up to harvest was 100% in the above said treatments but only 35 percent in the control. Application of bio-agents also increased the yield attributing characters.

### **Stage wise nutrient requirement for Udhayam banana**

Application of 300g N and 400g K<sub>2</sub>O in the ratio of 7:2:1 N and 4:3:3 K<sub>2</sub>O in seven splits during vegetative stage (210g N & 160g K), flowering stage (60g N & 120g K) and bunch development (30g N & 120g K) stages advanced the fruit maturity (110 days) and also recorded the highest bunch weight and fruit TSS (31.2°B). Application of 300g N and 400g K<sub>2</sub>O in the ratio of 7:2:1

and 4:3:3 at vegetative, flowering and bunch development stages recorded the highest B:C ratio of 3.43.

In the second ratoon Poovan banana application of 20 kg FYM, 0.9 kg neem cake, 2.0 kg vermicompost and 0.9 kg groundnut cake (T3) recorded the highest bunch weight with more number of hands and fingers/ bunch.

### **Drought stress tolerance in banana**

The stress imposed during 5<sup>th</sup> month after planting at 19-20% soil moisture level resulted in bunch malformation and reduction in number of fingers and bunch weight. The plants primed with 0.1mM salicylic acid as a foliar spray before imposing soil water deficit stress, produced normal bunch.

### **Enhancement of shelf-life bananas by biochemicals**

Shelf-life of pre climacteric banana with biochemicals was studied on fruit ripening enzyme levels; indicated that pectate lyase and pectin methylesterase activities were around five times and 40-times higher in climacteric Grand Naine and in Poovan peel and pulp respectively. Cellulase activity and Chlorophyllase activity were high in climacteric (ripening stage 6) Grand Naine and Poovan bananas than pre climacteric green bananas.

### **Evaluation of shelf-life of banana leaves**

The varieties Poovan, Karpuravalli and Udhayam recorded six days green leaf shelf-life, which is comparable with wild species like Elavazhai and Phirima while Rasthali, Saba, Monthan and Kungsa wild registered five days shelf-life. Pachanadan banana recorded the minimum shelf-life of three days.

### **Survey for banana weevils in Assam**

Survey was conducted in the major banana growing areas of Assam viz., Kamrup and Morigoan districts. A new small weevil was recorded infesting on the outer leaf sheath in an aggregation pattern and was identified as *Athesapenta cyperi*

Marshall. Entomopathogenic fungi infection was recorded on the same weevil and identified as *Beauveria bassiana*. The weevil damages on the stem and jelly



exudation was noticed. Stem weevil infestation was recorded in cv Malbhog and the stem weevil infestation was completely free on wild balbisiana, Bhimkol. Corm weevil infestation was very meagre.

### Identified volatile components as stem weevil attractant from susceptible cultivars

Stem weevil active volatile components from the leaf sheath extracts were identified using GC-EAD facility from susceptible cvs. Poovan and Nendran. *Musa balbisiana* cv. Attikol a wild species did not show any response indicating that weevil active volatiles are not present in the extract.

### Radio talks through All India Radio, Tiruchirapalli

Name of the Scientist	Topic	Date of broadcast
I. Ravi	Use of plant hormones in banana production (Tamil)	17.10.2013
V. Kumar	Season based banana cultivation techniques (Tamil)	19.09.2013
K.J. Jeyabaskaran	Nutrient management in banana cultivation Question and Answer (Tamil)	19.07.2013
	Fertilizer management in banana (Tamil)	24.07.2013
M.S. Saraswathi	Importance of tissue culture banana (Tamil)	28.05.2013

### Exhibitions conducted/ participated

Name of the Events	Organiser/ venue	Date(s)
International Conference on Tropical Roots and Tubers Crops for sustainable Livelihood under Changing Agro Climate	Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala	9-12 Jul., 2013
Kissan Mela - 2013	NRCB, Tiruchirappalli, Tamil Nadu	21 Aug., 2013
8 <sup>th</sup> National Conference on KVK-2013	ICAR & UAS, GKVK campus, Bengaluru, Karnataka	23-25 Oct., 2013
Banana Festival - 2013	CII and Tamil Nadu Banana Grower Federation, CODISSIA, Coimbatore, Tamil Nadu	14-15 Dec., 2013
Agri Expo - 2013	Dinamalar (Tamil Daily), Thanjavur, Tamil Nadu	19-22 Dec., 2013
26 <sup>th</sup> Kerala National Science Congress- National Science Expo	Kerala State Council for Science, Technology & Environment, Kalpetta, Wayandu, Kerala	28-31 Jan., 2014
National Agriculture Fair cum Exhibition (Krishi Vasanth - 2014)	CII, Govt. of Maharashtra and Govt. of India, Central Cotton Research Institute, Nagpur, Maharashtra	9-13 Feb., 2014
Agri Expo - 2014	Puthiya Thalaimurai Media, National College, Tiruchirappalli, Tamil Nadu	21-23 Feb., 2014



Shri Sharad Chandra Pawar, Hon'ble Union Minister for Agriculture & Food, Govt. of India and Dr. S. Ayyappan, Secretary-DARE & Director General-ICAR, New Delhi visit to NRCB stall during 8<sup>th</sup> National Conference on KVK- 2013, Bengaluru, Karnataka on 23.10.2013.



Farmers visit to NRCB stall during Krish Vasanth 2014, Nagpur, Maharashtra on 10.02.2014

### List of trainings offered

Title	Date (s)	Nos.	Course Coordinator
Post harvest handling, packing, storage and ripening in banana for domestic and export markets	9-13 Dec., 2013	7	K.N. Shiva
Crop protection scientists of AICRP banana Centers-Training cum workshop	4-5 Mar., 2014	16	B. Padmanaban, P. Sundararaju, R. Thangavelu and R. Selvarajan
Awareness Cum Training Programme on Protection of Plant Varieties and Farmers Rights	24 Mar., 2014	100	M.M. Mustafa and S. Uma



Participants of the training cum workshop on Crop Protection Scientists of AICRP (Fruits) Centers



Participants of the training on Post-harvest handling, packing, storage and ripening in banana for domestic and export markets

### LINKAGES AND COLLABORATIONS

- A collaborative project was initiated with CIAE, Regional Station, Coimbatore for Developing banana central core stem slicer and juice extractor

and Developing postharvest mechanization package for banana central core.

- A MoU was signed with St. Joseph College, Tiruchirapalli, Tamil Nadu for training woman in banana post harvest and value addition.

## Awards

Name	Award	Awarded by / Organizer / Date
S. Uma, V. Kumar and S. Backiyarani	Fellow CHAI	Confederation of Horticultural Associations of India, New Delhi
R. Selvarajan	Best Poster	Asia Pacific Congress of Virology (Virocon-2013), Amity University Uttar Pradesh, Noida, 17-20 <sup>th</sup> Dec., 2013
V. Kumar	Best Lead Paper Presentation	National Seminar-cum Workshop on Canopy Management and HDP in Sub-tropical Fruit Crops, CISH, Lucknow during 22-24 Oct., 2013
K.N. Shiva	Best Oral Presentation	National Seminar on Plastics in Agriculture, Indian Plastics Institute, Chennai, 21 <sup>st</sup> Sept., 2013

## PUBLICATIONS

### Research Papers Published in Journals

#### Inter National

- Arun, K., Uma, S., Saraswathi, M.S., Backiyarani, S. and Durai, P. 2013. Seed priming studies on *in-vitro* germination and regeneration of hybrid banana embryos (*Musa spp*). *Seed Sci. Res.* 41: 439-451.
- Backiyarani, S., Uma, S., Arunkumar, G., Saraswathi, M.S. and Sundararaju, P. 2013. Cloning and characterization of NBS-LRR resistance gene analogues of *Musa spp.* and their expression profiling studies against *Pratylenchus coffeae*. *African J. of Biotech.* 12(27): 4256-4268.
- Backiyarani, S., Uma, S., Arunkumar, G., Saraswathi, M.S. and Sundararaju, P. 2014. Differentially expressed genes in incompatible interactions of *Pratylenchus coffeae* with *Musa* using suppression subtractive hybridization *Physiol. and Mol. Pl. Pathol.* 86: 11-18.
- Balasubramanian, V. and Selvarajan, R. 2013. Genetic diversity and recombination analysis in the coat protein gene of banana bract mosaic virus. *Virus genes.* 48(3): 509-17.

#### National

- Backiyarani, S., Sundararaju, P., Mayilvaganan, M., Uma, S., Saraswathi, M.S. and Arunkumar, G. 2013. Time Course expression studies during *Musa Pratylenchus coffeae* interaction. *Ind. J. Hort.* 70(2):217-222.
- Mary Sheeba, M., Selvarajan, R. and Mustafa, M.M. 2013. Prediction and identification of microRNA from banana infected with Banana Streak Mysore Virus (BSMYV). *Madras Ag. J.* 100(4-6): 513-518.

- Mayil Vaganan, M., Ravi, I., Sarumathi, S., Nandakumar, A., Sundararaju, P. and Mustafa, M.M. 2014. Phenylpropanoid enzymes and phenolic polymers and metabolites as chemical defenses to infection of *Pratylenchus coffeae* in roots of resistant and susceptible bananas (*Musa spp.*). *Ind. J. Expt. Biol.* 52(3): 252-260.

#### Chapters in books

- Selvarajan, R. and Balasubramanian, V. 2014. Hostvirus interactions in banana-infecting viruses (Eds-R.K. Gaur et al). *Plant virus host interaction molecular approaches and viral evolution.* Elsevier Academic Press. pp.57-78. ISBN: 978-0-12-411584-2.
- Selvarajan, R., Thangavelu, R., Balasubramanian, V. and Mustafa, M.M. 2013. Banana. In. (H.P. Singh-Eds.), *Advances in horticulture biotechnology diagnostics for horticulture crops* (Vol. VII), Westville Publishing House, New Delhi. pp. 30-57. ISBN : 9788185873961.

#### Technical Bulletin

- Shiva, K.N., Mustafa, M.M. and Uma, S. 2014. (2<sup>nd</sup> Edn). Protection of plant varieties and Farmer's Rights (PPV & FRA) and Copy rights. National Research Center for Banana, Trichy, Tamil Nadu. pp. 26.

## CONSULTANCY SERVICES AND COMMERCIALIZATION OF TECHNOLOGIES

- Polyclonal antiserum produced for CMV, BBrMV and BBTv was sold to tissue culture companies and also to the State Agricultural Universities *viz.*, KAU, APHU and Department of Horticulture, Kerala. An amount of Rs. 35,000/- has been realized.
- USAID Consultancy Programme for Transforming Eastern India's Economies through Innovative Rural

Business Hubs (RBH) in Collaboration with CII-FACE, New Delhi, Sahai-e-Village Ltd., Kolkata

- Mother culture of cv. Udhayam banana sold to HRC, Nagicherra through MTA
- Licensing of Technical Know-How technology transferred to four entrepreneurs viz, Banana Fig to Mr. K. Prabhakaran, Malappuram, Kerala; Post-Harvest Handling, Packing and Storage of Central Core Stem to Mr. A. Ananth, Namakkal, Tamil Nadu; Flower (thokku) and Stem pickles to Mr. S, Sreejith, Kollam, Kerala and Mr. J. Venkatesan, Bengaluru, Karnataka.

### RAC/ IMC/ IRC MEETINGS

#### RAC Meeting

Research Advisory Committee meeting of the Centre was conducted on 27 and 28 December, 2013, wherein all the members of RAC including the Chairman Dr. G. L. Kaul, Former VC, AAU attended the meeting. Recommendations generated from the meeting were approved by the Council and communicated the same to all the members.



Dr. G.L. Kaul, Chairman, RAC chairing the RAC meeting

#### IMC Meeting

The meetings of the Institute Management Committee was held on 13.5.2013, 4.10.2013 and 19.3.14 under the chairmanship of Dr. M. M. Mustafa, Director, NRC for Banana. During this meeting, various policy decisions were discussed and recommended for approval to the Council.



Dr. M.M. Mustafa, Director NRCB, chairing the 20<sup>th</sup> IMC meeting

#### IRC Meeting

The seventeenth Institute Research Council meeting was held on 4, 17 and 20 April, 2013 under the Chairmanship of Dr.M.M. Mustafa, Director, NRCB. The Member Secretary welcomed the Chairman and other members of IRC. After introductory remarks by the Chairman, the research programmes, comments of the last IRC, action taken on the comments, salient achievements for the year 2012-13 and technical programme for the year 2013-14 were presented by the scientists were reviewed.



Dr. M.M. Mustafa, Director NRCB, chairing the 17<sup>th</sup> IRC meeting

### TRAINING/ REFRESHER COURSES ATTENDED BY THE SCIENTISTS (HRD)

Name of the Scientist	Name of the training programme /Venue	Period
S. Uma, R. Thangavelu and R. Selvarajan	Management Development Programme on Leadership Development NAARM, Hyderabad	26 <sup>th</sup> Nov., 7 <sup>th</sup> Dec., 2013 26 <sup>th</sup> Aug., - 6 <sup>th</sup> Sept., 2013
I. Ravi	Nodal officer installation - cum - training workshop for NAIP' SSCNARS for NARS, NAARM, Hyderabad	18-19 <sup>th</sup> Oct., 2013
	Adaptation and mitigation strategies for climate resilient agriculture, CRIDA, Hyderabad	22-31 <sup>st</sup> Oct., 2013
K. N. Shiva	National Training on Non-thermal and Non-chemical Processing Technologies Application of High Pressure and Pulsed Light Technology for Food Processing, CIFT, Cochin, Kerala	18-31 <sup>st</sup> Oct., 2013
S. Backiyarani	International training programe on Bioinformatics training course applied to the <i>Musa</i> genome, Montpellier, France	18-22 <sup>nd</sup> Nov., 2013
M. S. Saraswathi	International training on standardization of protocols of tissue culture and somaclonal variant selection in <i>Musa</i> improvement, TBRI, Pingtung, Taiwan	21-26 <sup>th</sup> Oct., 2013

## OTHER INFORMATIONS

### Kissan Mela

The National Research Centre for Banana celebrated its 20<sup>th</sup> Foundation day as “Banana Kissan Mela” with the theme on “Banana fruit care” on 21<sup>st</sup> August 2013. Dr. M. M. Mustafa, Director, NRCB presided over the function and Thiru P. Velmurugan, M.A., M.L., Principal District Judge, Tiruchirapalli was the chief guest of the function and the delivered chief guest address. On the occasion, a compilation on 20 years of research achievements was released by the chief guest.



Farmer receives the “Best Banana Grower” Award at Kissan Mela

### Director General, ICAR visits NRC Banana, Tiruchirapalli

Dr. S. Ayyappan, Director General-ICAR and Secretary- DARE, Government of India, New Delhi, visited National Research Centre for Banana on 9.10.2013 and inaugurated the newly constructed Screen House, Net House and Glass House at NRCB, Tiruchirapalli. He encouraged the scientists to go for more patenting of the technologies.



Dr. S. Ayyappan, Director General, ICAR declare open the Screen House at NRCB on 9.10.2013

### Protection of Plant Varieties and Farmers' Rights Awareness Programme

An awareness programme on Protection of Plant Varieties and Farmers' Rights was held on 24.03.2014 at National Research Centre for Banana, Tiruchirapalli to create an awareness to the farmers about their rights on the local varieties and landraces of plants and the need for

### Distinguished Visitors

Name and Address	Date
Prof. Harvna Yakubu, V.C, University of Development Studies, Tamale, Ghana	13.5.2013
Prof. Dr. S. Sathiamoorthy, Former Director, NRCB, Coimbatore	16.5.2013
Shri Siraj Hussain, IAS, Secretary, Ministry Food Processing, GOI, New Delhi	8.6.2013
Dr. S. Ayyappan, Secretary-DARE & Director General-ICAR, New Delhi	9.10.2013
Dr. G. L. Kaul, Former VC, AAU, Ghaziabad, U.P. Chairman-RAC and members	27.12.2013

protection of the indigenous plant types. In this programme, lectures were delivered by Scientists. Around 100 progressive farmers from different parts of the state participated.

Dr. S. Sathiamoorthy, Former-Director of the NRC banana was the chief guest and gave away awards to the farmers for conservation of seeds and plant materials. Dr. M. M. Mustafa, Director in his presidential speech dealt upon the role and importance of PPV and FR and emphasised the need of the farmers for protecting the traditional varieties of rice, banana and other crops.

Mr. Siddhar from Thanjavur and Mr. Thirumalai of Kolli hills, Namakkal district were felicitated and given awards for their conservation efforts of different traditional rice varieties and banana varieties like Karuvazhai, Namarai and Sambal vazhai.



Mr. Siddhar receiving the Award

### National Science Day Celebration at NRCB

The National Research Centre for Banana (ICAR), Trichy celebrated 'National Science Day' on 28<sup>th</sup> February, 2014 remembering 86<sup>th</sup> year of Dr. C. V. Raman's Nobel Prize winning discovery of “Raman Effect” with a theme on 'Fostering Scientific Temper' among school and college students. Director of the Centre, Dr. M. M. Mustafa inaugurated the seminar, exhibition and delivered the presidential address. Dr. B. Padmanaban, Principal Scientist and Co-ordinator of the program explained the activities of NRCB to the students. The primary objective was to expose the students to research to create an awareness and motivation among the students.





RAC members with Director and Scientists of NRCB on 27.12.2013



Shri Siraj Hussain, IAS, Secretary, Ministry Food Processing, Govt. of India, New Delhi visit to NRCB on 8.6.2013

## Staff News

Name	Position	w.e.f
Dr. P. Sundararaju, Principal Scientist	Superannuated from service	30.04.2013
Ms. Richa Sood, Assistant	Resigned from service	30.05.2013
Mr. R. Krishnamurthy, Assistant	Promoted as Assistant Administrative Officer	01.07.2013
Dr. I. Ravi, Senior Scientist	Promoted as Principal Scientist	01.01.2011
Dr. V. Kumar, Senior Scientist	Promoted as Principal Scientist	01.01.2011
Dr. K.J. Jeyabaskaran, Senior Scientist	Promoted as Principal Scientist	15. 07.2012
Mr. R. Neela Mega Shymala Kannan, Steno Gr. III	First Financial up-gradation granted under MACPS	01.09.2013



Dr. P. Sundararaju, Principal Scientist, superannuated from service on 30.04.2013.



हर कदम, हर डगर  
किसानों का हमसफर  
भारतीय कृषि अनुसंधान परिषद

*Agriseach with a human touch*

Published by : **Dr. M.M. Mustafa**, Director  
Edited by : **Dr. B. Padmanaban** and **Mr. P. Ravichamy**

**NATIONAL RESEARCH CENTRE FOR BANANA**  
Thogamalai Road, Thayanur Post, Tiruchirapalli - 620 102, Tamil Nadu, India.  
Phone : 0431 - 2618106, 2618104, Mobile : 94425 53117 Fax : 0431 - 2618115  
E-mail : [directornrcb@gmail.com](mailto:directornrcb@gmail.com); web : [www.nrcb.res.in](http://www.nrcb.res.in)