



# ICAR - NRCB News



ICAR - National Research Centre for Banana  
Tiruchirapalli - 620 102, Tamil Nadu, India



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## From Director's Desk

India is the largest producer of banana in the world, producing 29.7 million tonnes (25.58% global banana production) from an area of 0.82 million hectares (15.5% global banana area) with a productivity of 37 tonnes / hectare. Among the production constraints, wilt disease caused by *Fusarium oxysporum* f. sp. *cubense* (Foc) is one of the important biotic constraints. The disease is widespread in most of the banana growing states of India, with disease severity as high as 80-90%. Susceptible cultivars to Foc include 'Silk' (AAB), 'Ney Poovan' (AB), 'Pisang Awak' (ABB), 'Pome' (AAB), 'Bluggoe' (ABB) and 'Monthan' (ABB). Diversity analysis carried out at this institute on 200 Foc isolates collected from different parts of India indicated the presence of 10 different VCG groups. Recently, molecular markers for the identification of pathogenic *Fusarium* present in the soil as well as in planting material have been developed. ICAR – NRCB has identified an effective fungal antagonist, *Trichoderma* spp. which has effectively controlled the soil borne inoculum of the *Fusarium* pathogen.

A mass-production protocol at farm level using banana farm waste has been developed for the cost-effective management of the disease. Morphological and molecular characterization of isolates of leaf-spot disease (*Mycosphaerella eumusae*), another important fungal disease of banana, was carried out at this institute. Spray schedule for its effective management has been developed. ICAR – NRCB developed a method for extension of shelf-life of banana fruit by treating with fungal – botanical complex (*Trichoderma asperellum* (pr2) and zimmu aqueous leaf extract). In this issue work carried out under banana disease management is highlighted.

## RESEARCH HIGHLIGHTS

### Characterization and management of fungal diseases of banana

**Wilt disease, *Fusarium oxysporum* f.sp. *cubense* (Foc)**

#### Characterization

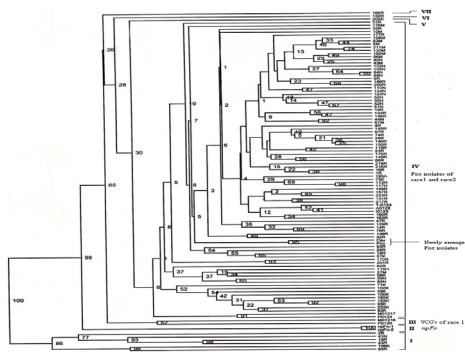
A total of 225 *Fusarium* isolates were collected and characterized by morphological, vegetative

## CONTENTS

|                                                            |   |
|------------------------------------------------------------|---|
| Research Highlights                                        | 1 |
| Transfer of Technology                                     | 3 |
| Trainings                                                  | 4 |
| Consultancy Services and Commercialization of Technologies | 5 |
| Research Papers                                            | 5 |
| Other Informations                                         | 5 |



compatibility grouping (VCG) and molecular methods. Based on VCG study, 10 different groups were identified and diversity map of Foc in India was prepared. The ISSR analysis showed seven different clusters and the presence of wide genetic diversity among the Foc isolates in India. Besides, it distinguished the unknown Foc strain obtained from cv. Grand Naine (Cavendish-AAA) and Poovan (Mysore-AAB) from the other Foc isolates (Fig).



Diversity Analysis of Foc using ISSR marker

### First report of Foc Race 1 infecting Cavendish banana in India

Race 1 of Foc was isolated and identified from Grand Naine plants grown in Chinnamanur, Theni district, Tamil Nadu, India. Pathogenicity assays and VCG were carried out which showed that nit-1 mutants generated from wild strain of Foc isolated from cv. Cavendish formed robust heterokaryons with nit-M tester 0124 of DPI&F, Brisbane, Australia and also with nit-M tester obtained from an isolate of Foc isolated from Karpuravalli (Pisang Awak-ABB). Study on virulent nature of the strain indicated that the Cavendish strain caused severe wilt disease (score of 6) in different genomic groups of banana such as Rasthali (Silk-AAB), Karpuravalli (Pisang Awak-ABB), Ney Poovan (AB), Poovan (Mysore-AAB), Monthan (ABB) and Grand Naine (Cavendish-AAA) and not in Red Banana (AAA) and Nendran (French Plantain-AAB).

### Foc specific SCAR marker

A Foc specific SCAR marker to distinguish pathogenic Fusarium from non-pathogenic form and also detect the presence of Fusarium in soil, corm and pseudostem was developed. This marker was also validated in the infected plant, soil and also gel based and RT-PCR based assays using 167 Foc isolates, 24 VCGs belonging to race 1, 2 and 4, two isolates of Foc, 11 isolates of other species of Fusarium and 32 isolates of non-pathogenic Fusarium.

### Management

#### Chemical method

Dipping the pared suckers in carbendazim solution (0.1%) for 45 minutes followed by drenching of carbendazim (0.1%) around the plants @ 3-4 litres/plant on 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> month after planting and stem injection with carbendazim (0.1%) @ 4 ml/plant at 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> month after planting resulted in complete suppression of Fusarium wilt disease in cv. NeyPoovan.

#### Biological/ botanical method

Combined application of *Penicillium pinophilum* (Bc2) + rhizospheric *Trichoderma* sp. (NRCB3) and *Trichoderma asperellum* (Prr2) + *Bacillus flexus* (Tvpr1) and Zimmu leaf extract (50%) during planting, two months after planting and 4 months after planting recorded complete suppression of the disease.

### Leaf spot disease, *Mycosphaerella eumusae* Characterization

A total of 99 isolates of leaf spot pathogen were collected from different banana growing states in India. All these isolates were identified as *Mycosphaerella eumusae* based on cultural and morphological characters. For confirmation, the rDNA-ITS region of all the 99 isolates of *M. eumusae* was sequenced and the Blast analysis showed 99-100% similarity with *M. eumusae*.

### Spray schedule for the management of leaf spot disease

| Days after planting | Qty of chemicals/ litre of water                    |
|---------------------|-----------------------------------------------------|
| 150 days            | 1g Carbendazim + 10ml mineral oil (Banole ®-TRE)    |
| 175 days            | 1ml Propiconazole + 10ml mineral oil (Banole ®-TRE) |



|          |                                                                                        |
|----------|----------------------------------------------------------------------------------------|
| 200 days | 1g Companion + 10ml mineral oil (Banole ®-TRE)                                         |
| 225 days | 1.4 g Nativo (Trifloxystrobin+ tebuconazole) / litre + 10ml mineral oil (Banole ®-TRE) |
| 250 days | 1ml Propiconazole + 10ml mineral oil (Banole ®-TRE)                                    |
| 275 days | 1g Companion + 10ml mineral oil (Banole ®-TRE)                                         |
| 300 days | 1g Carbendazim + 10ml mineral oil (Banole ®-TRE)                                       |

### Management of post harvest diseases of banana

Banana fruits treated with *Trichoderma asperellum* (pr2) extended the total shelf life of banana fruits up to 28 days (GL of 13 and YL of 15 days) at 23°C and 55 days (GL of 42 days and YL of 13 days) at 13°C. Similarly, ACC deaminase producing bacterial isolate (ACC13) extended the shelf life of banana hand up to 24 days (GL of 12 days and YL of 12 days) at 23°C and 50 days (GL of 40 days and YL of 10 days) at 13°C followed by Zimmu leaf extract, which extended the shelf life of banana hands up to 23 days (GL of 10 days and YL of 13 days) at 23°C and 37 days (GL of 25 days and YL of 12 days) at 13°C. In the control treatment (untreated hands), the total shelf life of banana hand was only 15 days at 23°C and 22 days at 13°C.

### Outbreak of banana skipper in Southern India

The banana skippers, *Erionota thrax* and *E. torus* (Lepidoptera: Hesperidae) are pests on banana in North East India. Damage symptoms include presence of cylindrical leaf rolls and irregular cuts on the margins of leaves. Pupation occurs inside the leaf-roll. Recently outbreaks of *E. torus* were recorded in many parts of Kerala, Karnataka and Tamil Nadu. This species was initially wrongly identified as *E. thrax*. These outbreaks represent as expansion in the known geographic distribution of *E. torus*.

Suggested management measures to check the pest include

- Collection and destruction of leafroll which harbor the larvae and pupae.
- Foliar spray of Chlorpyrifos 20 EC (2.5ml/litre with adjuvant 1ml/litre ) or Profenophos (2.0 ml/litre with adjuvant 1ml/litre).
- Foliar spray of microbial agents like *Bacillus thuringiensis* @ 2.5g / litre (200g / acre).



Larva



adult

## TRANSFER OF TECHNOLOGY

### Training

About 2600 visitors comprising banana farmers/ entrepreneurs/ horticultural/ agricultural officers/ college students visited ICAR-NRCB and they were briefed about improved production, protection technology, postharvest management and value addition of banana.

### Television talk

Dr. K. N. Shiva gave television talk on production of handicrafts from banana fiber (*Vazhai naarilirunthu khaivinaiporutkal undakkuthal*) to Puthia Thalaimurai TV, Chennai from 12 to 14.1.2015.

### Exhibitions conducted / participated

| Name of the Events           | Organiser / Venue                      | Date           |
|------------------------------|----------------------------------------|----------------|
| Island Kisan Mela, 2015      | ICAR-CARI, Port Blair, Andaman Islands | 9 & 10.4.2015  |
| Agriculture Exhibition, 2015 | ICAR, Pipra Kothi, Motihari, Bihar     | 20 & 21.8.2015 |
| Kisan Mela, 2015             | ICAR – NRCB, Tiruchirapalli, TamilNadu | 28.8.2015      |



5<sup>th</sup> Mega Agriculture Fair, Agri Expo.,  
2015

Dinamalar -Tamil Daily Newspaper, Vestri  
School ground, Tiruchirappalli, Tamil Nadu

19 to 21.9. 2015



Dr. S. Ayyappan, Secretary - DARE & Director General - ICAR, New Delhi visit to ICAR-NRCB stall during NRCB - Kisan Mela.



Visitors at ICAR-NRCB stall during Agri Expo - 2015, Vestri School ground, Tiruchirappalli.

### Trainings offered

| Training Programme                                                                                                                            | Co-ordinator(s)                          | Date                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------|
| Improved Production and Post-harvest Management Technologies in Banana to officers of Malappuram District, Kerala (sponsored by SHM, Kerala). | V. Kumar, K.J. Jeyabaskaran & K.N. Shiva | 8 to 9.4. 2015                           |
| Production of banana fig to entrepreneurs from Malappuram & Kannur, Kerala.                                                                   | K.N. Shiva                               | 25 to 26.6. 2015<br>and 14 to 15.7. 2015 |
| Production of value added products from banana to farmers of Erode, T.N.                                                                      | K.N. Shiva                               | 6 to 10.7. 2015                          |
| Production of banana flour based health drink and soup mix to Mr. K. Dinesh, Nellore, A.P.                                                    | K.N. Shiva                               | 8 to 9.7.2015                            |



Participants of the training on improved production and post-harvest management technologies in banana .



Participants of the training on production of value added products from banana

### Human Resource Development

| Staff       | Training programme /Venue                                                                        | Period          |
|-------------|--------------------------------------------------------------------------------------------------|-----------------|
| I. Ravi     | Consultancy project management, NAARM, Hyderabad                                                 | 3 to 7.7.2015   |
| K. N. Shiva | Business planning for developing new agro-technology enterprises, ICAR-CTCRI, Thiruvananthapuram | 2 to 11.9. 2015 |



|              |                                                                                          |                        |
|--------------|------------------------------------------------------------------------------------------|------------------------|
| P. Giribabu  | Molecular characterization of nematodes, ICAR - NBAIR, Bangalore                         | 1 to 5.9. 2015         |
| N. Marimuthu | Technology for processing fruits and vegetables into value added products, CFTRI, Mysuru | 31.8.2015 to 11.9.2015 |
| P. Murugan   | Various modules using Oracle ERP, ICAR – IASRI, New Delhi                                | 11 to 16.5.2015        |

### Awards and Honors

| Recipient     | Award / Honor received                                                                                                                                                                                              |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| R. Selvarajan | DST-Lockheed Martin India award for the innovations on banana virus diagnostics, Fellow of Confederation of Horticultural Society of India (CHAI), 2014 and Fellow of Indian Phytopathological Society (FPSI), 2014 |
| ICAR - NRCB   | Best stall award - 2015 at 5th Mega Agri Expo (Dinamalar), Vestry School ground, Tiruchirappalli, T.N.                                                                                                              |

### CONSULTANCY SERVICES AND COMMERCIALIZATION OF TECHNOLOGIES

- Four hundred and ninety-six batches of tissue cultured banana cvs. Grand Naine, Robusta, Williams and Nendran from different tissue culture companies were tested for their fidelity using SSR and ISSR markers under DBT – ATL and issued test reports with revenue generation of Rs.8,48,160/-.
- Under licensing of technical know-how production of banana fig and banana flour based health drink and soup-mix were given to entrepreneurs of Kerala and Andhra Pradesh.

### RESEARCH PAPERS

1. Anuradha, C., Balasubramanian, V. and Selvarajan, R. 2015. Sequence motif comparison and homology modeling of helper component proteinase (HC-Pro) of banana bract mosaic virus. *Plant Pathology Journal* 14: 123-129.
2. Backiyarani, S., Uma, S., Saraswathi, M.S., Saravanakumar, A.S. and Chandrasekar, A. 2015. Transcriptome analysis of banana (*Musa balbisiana*) based on next generation sequencing technology. *Turkish Journal of Agriculture and Forestry* 39: 705 - 717.
3. Muthusamy, M., Uma, S., Backiyarani, S. and Saraswathi, M. S. 2015. Genome-wide screening for novel, drought stress-responsive long non-coding RNAs in drought-stressed leaf transcriptome of drought-tolerant and susceptible banana (*Musa* spp) cultivars using

Illumina high-throughput sequencing. *Plant Biotechnol. Rep. Online* DOI 10.1007/s11816-015-0363-6

4. Thangavelu, R. and Gopi, M. 2015. Field suppression of Fusarium wilt disease in banana by the combined application of native endophytic and rhizospheric bacterial isolates possessing multiple functions. *Phytopathologia Mediterranea*, 54: 241 - 252.
5. Thangavelu, R. and Gopi, M. 2015. Combined application of native *Trichoderma* isolates possessing multiple functions for the control of Fusarium wilt disease in banana cv. Grand Naine. *Biocontrol Science and Technology*, 25: 1147 – 1164.

### Technical hand book

Uma, S., Mayil Vaganan, M., Giribabu, P., Ravichamy, P. and Kannan, R.N.M.S. 2015. Banana production technology in Tamil (Vazhai urpathi thozhilnupagal-compiled and edited document) published by Dr. B. Padmanaban, Acting Director, ICAR-NRCB, Tiruchirappalli during NRCB 22<sup>nd</sup> foundation day on 28.8.2015.

### OTHER INFORMATION

#### New RAC for ICAR - NRCB

ICAR has constituted the Research Advisory Committee (RAC) for ICAR – NRCB for a period of three years (2015 to 2018) with the following members.



|                   |                                                                    |
|-------------------|--------------------------------------------------------------------|
| Chairman          | Dr. S. N. Pandey, Retd. ADG (Hort. Sci.), ICAR, New Delhi          |
| Member            | Dr. P. Anand Kumar, Principal Scientist, ICAR – IIRR, Hyderabad    |
| Member            | Dr. N. Kumar, Retd. Professor (Hort.), TNAU, Coimbatore            |
| Member            | Dr. T.V.K. Singh, Dean, College of Agriculture, ANGRAU, Hyderabad  |
| Member            | Dr. A. K. Mishra, Principal Scientist & Head, ICAR – CISH, Lucknow |
| Ex-Officio member | Assistant Director General (Hort.Sci.), ICAR, New Delhi            |
| Ex-Officio member | Director, ICAR – NRCB, Tiruchirapalli                              |
| Member secretary  | Dr. B. Padmanaban, Principal Scientist, ICAR – NRCB                |

## IRC Meeting

The 19th Institute Research Council (IRC) meeting was held on 30 May, 2015 under the chairmanship of Dr. M. M. Mustaffa, Director, ICAR – NRCB. Dr. R. Selvarajan, Member Secretary, IRC welcomed the chairman and other members of the IRC. After



introductory remarks by the Chairman, research projects, comments of the last IRC, action taken report, salient achievements for the year 2014-15 and technical programme for the year 2015-16 presented by the scientists were reviewed.

## Banana Kisan Mela cum ICAR - NRCB foundation day

ICAR – NRCB celebrated its 22<sup>nd</sup> foundation day as Kisan Mela with the theme on “Healthy soils for healthy life” on 28 August, 2015. The mela was presided over by Dr. S. Ayyappan, Director General (ICAR), Dr. Sreenath Dixit, Zonal Project Director, Zonal Project Directorate, Zone VIII (ICAR), Dr. B.



Padmanaban, Acting Director, ICAR – NRCB and Dr. M. Jawaharlal, Dean, Horticultural College and Research Institute for Women (TNAU), Tiruchirapalli.

Dr. S. Ayyappan delivered the chief guest lecture. In his speech, he praised banana farmers of Theni for their professionalism and emphasized the need for bringing rural youths to agriculture (ARYA). He inaugurated the stalls and distributed prizes to leading banana growers and entrepreneurs. Scientists of ICAR – NRCB delivered lectures on banana production, protection and post-harvest technologies and interacted with banana farmers.

## Independence Day Celebration

Independence Day was celebrated at our institute on 15 August, 2015. Dr. B. Padmanaban, Acting Director hoisted the national flag and delivered speech. He urged for inculcating team work among the staff.

## Sadhbhavna Divas

Sadhbhavna divas was observed at our Institute on 20 August, 2015. In order to promote National integration and communal harmony, a pledge was taken by the staff. On this occasion, Swamy Shri Ashok Govind Das, ISKON, Tiruchirapalli delivered a special lecture on importance of integrity and communal harmony through quotes from Bhagavat Gita.

## Hindi Fortnight Celebrations

ICAR – NRCB celebrated ‘Hindi Fortnight 2015’ from 16 to 30 September, 2015. The inaugural function was held on 16 September, 2015 under the chairmanship of Dr. B. Padmanaban, Acting Director, ICAR - NRCB, Tiruchirapalli. As part of Hindi week celebrations, various competitions in Hindi viz., “poem recitation”, “see and tell”, “hindi song”, “hindi writing”, and “hindi newspaper reading” were



conducted in which scientific, technical administrative and supporting staff of the Centre actively participated and exposed their talents. On 30 September, the valedictory function of the Hindi Fortnight 2015 celebrations was held in which Mr. Vikram Kumar,



Zonal Official Language Officer, State Bank of India, Tiruchirapalli graced the occasion as Chief Guest. In his address he highlighted the importance of use of Hindi language in day-to-day routine in office and emphasized that knowledge of the Hindi language should be imparted to every citizen right from childhood in addition to his mother tongue. Dr. B. Padmanaban, in his Chairman's address, emphasized the importance of promoting Hindi as official language and the necessity of learning Hindi as 'Rajbhasha' by every staff. Dr. K. N. Shiva welcomed the gathering and also read out the report on the Hindi fortnight 2015 at the Centre. The programme came to an end with a vote of thanks by Dr. K.J. Jeyabaskaran,

Principal Scientist and Member, Official Language Implementation Committee of the Centre. Mr. B. Sathish, Senior Administrative Officer coordinated the entire programme.

### Sports Meet

ICAR – NRCB participated in ICAR Inter-Institutional Sports meet for south zone held at Kochi from 25 – 29 May, 2015.

### Medical Camp

Mahatma Eye Institute conducted "Eye check-up and consultancy campaign" at ICAR - NRCB on 21 April, 2015. Staff of our institute benefitted from this free eye campaign.

### Yoga Day Celebration

International Yoga Day was celebrated on 22 June, 2015. Dr. S. Thiyagarajan, Naturopathy, Yoga and Acupuncture consultant from Shri Jeyaranga Yoga centre, Tiruchirapalli practiced yoga to staff members.

### Digital India Week

ICAR – NRCB celebrated "Digital India Week" from 1 – 7 July, 2015. This event was organized to popularize Digital Locker – A Government of India's initiative for paper free storage of personal documents.

### Distinguished visitors

| Name, Designation and Address                                                                          | Date      |
|--------------------------------------------------------------------------------------------------------|-----------|
| Dr. K. S. Palanisamy, IAS, District Collector, Tiruchirapalli                                          | 2.7.2015  |
| Dr. S. Ayyappan, Director General (ICAR), New Delhi                                                    | 28.8.2015 |
| Dr. Sreenath Dixit, Zonal Project Director, Zonal Project Directorate, Zone VIII (ICAR), Bangalore     | 28.8.2015 |
| Dr. M. Jawaharlal, Dean, Horticultural College and Research Institute for Women (TNAU), Tiruchirapalli | 28.8.2015 |

### Staff news

| Name                                  | Event                                                       | Date      |
|---------------------------------------|-------------------------------------------------------------|-----------|
| Dr. J. Poorani, Principal Scientist   | Joined ICAR – NRCB by transfer from ICAR - NBAIR, Bangalore | 13.5.2015 |
| Dr. P. Suresh Kumar, Senior Scientist | Joined ICAR – NRCB by transfer from ICAR - NIASM, Baramati  | 27.5.2015 |



|                                                  |                                                                                                              |                 |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-----------------|
| Mr. Kishore Kumar Mahanti,<br>Scientist          | Transferred from ICAR-NRCB to ICAR - IIHR,<br>Bangalore                                                      | 20.6.2015       |
| Dr. A. Thirugnanavel, Scientist                  | Joined ICAR – NRCB by transfer from ICAR<br>research complex for NEH region, Nagaland Centre,<br>Jharanapani | 16.7.2015       |
| Dr. M. M. Mustafa, Director                      | Superannuation                                                                                               | 31.7.2015       |
| Dr. B. Padmanaban,<br>Principal Scientist        | Acting Director                                                                                              | 1.8.2015        |
| Mr. B. Sathish,<br>Senior Administrative Officer | Joined ICAR – NRCB by transfer from ICAR –<br>CPCRI, Kasaragod                                               | 27.8.2015       |
| Mr. Kasinathan,<br>Skilled Supporting Staff      | Joined ICAR – NRCB by transfer from ICAR – CARI,<br>Port Blair                                               | 14.9. 2015      |
| Mr. D. Ramachandramurthi                         | Promoted as Technical Officer                                                                                | W.e.f 11.8.2013 |



Dr. M. M. Mustafa, Director, superannuated from service on 31.7.2015



Published by **Dr. B. Padmanaban**, Acting Director  
 Edited by **Dr. P. Giribabu, Dr. I. Ravi, Dr. S. Backiyarani,**  
**Dr. J. Poorani and Mr. P. Ravichamy**

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