

NRCB NEWSLETTER

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ICAR - National Research Centre for Banana

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DIRECTOR'S DESK

I am happy to share this newsletter as the new Director of ICAR-National Research Centre for Banana, Tiruchirappalli, an exclusive research Centre working on improvement, production, protection and post-harvest management of banana in India. During 2022-23, the Centre has made significant achievements in developing new technologies for the benefit of banana stakeholders. I am glad to inform that the Centre received the prestigious 'Cold Chain Award' given by the Confederation of Indian Industry's Food and Agriculture Centre of Excellence (FACE) for significant contributions made in the cold storage of fresh and processed products of banana. The Centre also received special appreciation from ICAR-AICRP (Fruits) for the release of three new cultivars, Kaveri Haritha, Kaveri Kanya and Kaveri Saba. We successfully conducted an International workshop on 'Phenotyping for Drought Tolerance' in collaboration with Alliance Bioversity International - the International and Center for Tropical Agriculture (CIAT), Italy during 7-11 March, 2023 and a National level Consultative workshop on 'Export of GI and traditional bananas: Present scenario, trade opportunities and way forward' in association with APEDA, New Delhi, during 21-22



December, 2022. New initiatives during 2022-23 include 'Network project on Precision Agriculture', creation of 'Agri-Business Incubation Centre' to train and develop banana entrepreneurs and 'Drone Technology Demonstration' with financial support from DAC&FW, Govt. of India. The Centre has also started research on developing Nano formulation of 'Banana Shakthi', a popular micronutrient mixture with technical support from SASTRA University, Thanjavur. The Centre standardized protocols for export of fruits of traditional cultivar Red banana and with the collaboration of APEDA, New Delhi, fruits of red banana were successfully exported to Austria by air. The Centre signed MoA / MoU / MoCs with 10 research institutes / colleges / private companies for research collaborations and student exchange. The Centre organized 19 on-campus capacity development programs and 13 off campus training programs to banana farmers, FPOs, Government officials, public and private entrepreneurs under various schemes including SC & SP program, ATMA-SSEPERs, NHM etc. A total of 20 peer reviewed research papers were published in high impact factor journals.

In this issue, hybrids of ornamental banana developed at this Centre and the scope for their commercialization are discussed in detail in the 'IN FOCUS' section.


(R. Selvarajan)

IN FOCUS

Exploitation of crop wild relatives for the development of inter-specific ornamental banana hybrids

The search for novelty, originality, uniqueness, and beauty in plant species has increased in the recent past as the ornamental market is highly dynamic and demands constant novelties and new additions. Although banana has attained the status of the most widely produced, consumed and traded fruit on earth, its ornamental potential has not yet been exploited to the fullest extent. There are about 162 validly published taxa of Musaceae around the world, out of which 34 taxa (20%) are reported in India. The maximum diversity, representing about 90% of the total wild Musaceae diversity in India, exists in the Northeastern states with 30 taxa, of which 19 are endemic to this region. The second highest Musaceae diversity in India is found in the Andaman and Nicobar Islands, and the lowest in the Western and Eastern Ghats. Out of the three genera of Musaceae, *Ensete* Bruce ex Horan., and *Musa* L. are only present in India, and *Musella lasiocarpa*, commonly known as Chinese dwarf banana, golden lotus banana, or Chinese yellow banana, the sole species under the genus *Musella*, is not reported from India. These three genera include many valuable ornamental species that are yet to be fully exploited. Many of these crop wild relatives (CWRs) possess attractive bract colors like pink, red, bright red, orange red, orange, orange-pink, yellow, purple, and rarely even green, with less frequency. In some cases of CWRs, the fruit itself is brightly colored with pink, brown, and red, adding to the ornamental value of these plants. In general, the CWRs with ornamental potential are smaller in stature in terms of height and girth and hence they can be used as potted plants in home gardens. Several other appealing traits found in these CWRs are colored and variegated leaves, uneven colored or multicolored bracts, and mini fruits. The fruits from these ornamental Musaceae species are profusely seeded and unsuitable for human consumption. Most of the CWRs flower round the year, require less maintenance, and can easily be multiplied using rhizomes or corms. About one dozen CWRs from the genera *Ensete* and *Musa* in India are recognized as having high ornamental potential based on their growth characteristics and bearing of colorful minifructs and bright-colored bracts with upright inflorescence. No single species from *Callimusa* section under the *Musa* genus has been reported in India.

In India, only two species of *Ensete* – *E. glaucum* and *E. superbum* – are found. They are distributed in North-eastern and Peninsular India, respectively. Out of the 32 taxa reported in *Musa*, the following ten CWRs are recognized for their ornamental value based on their colorful bracts, mini-fruits and upright inflorescence.

1. *Musa aurantiaca* G. Mann ex Baker
2. *Musa markkuana* (M. Sabu, A. Joe & Sreejith) Hareesh, A. Joe and M. Sabu
3. *Musa ornata* Roxb.
4. *Musa rubra* Wall. ex Kurz.
5. *Musa sanguinea* Hook.f.
6. *Musa velutina* H.Wendl. & Drude
7. *Musa velutina* H.Wendl. & Drude var. *variegata* A. Joe, M. Sabu & Sreejith
8. *Musa argentii* Gogoi & Borah
9. *Musa mannii* H.Wendl. ex Baker
10. *Musa markkui* Gogoi & Borah

Development of inter-specific ornamental banana hybrids using CWRs at ICAR-NRCB

The major constraints in the cultivation or adoption of ornamental banana species are the difficulty in establishing them in the plains or out of their natural habitats. Additional drawbacks include lack of systematic breeding approaches for creation of new variability and insufficient planting materials, and ignorance among floriculturists about their potential ornamental value. Breeding of banana for ornamental purposes is still in its infancy. Therefore, the ornamental banana breeding program at ICAR-National Research Centre for Banana has mainly focused on exploiting the variability found in the wild *Musa* species to generate climate-resilient new and novel hybrids with high ornamental value and resistance to major pests and diseases.

Keeping this in mind, a systematic breeding works for ornamental banana was initiated in 2017 with the following four interspecific *Musa* crosses: *M. rubra* × *M. acuminata* subsp. *zebrina* (RZ), *M. ornata* × *M. rubra* (OR), *M. ornata* × *M. acuminata* subsp. *zebrina* (OZ), and *M. ornata* × *M. velutina* subsp. *markkuana* (OV).

Evaluation and shortlisting of interspecific ornamental banana hybrids for different ornamental uses

After primary and secondary hardening, 362 F1 hybrids obtained with four inter-specific crosses [RZ (37), OR (116), OZ (119), and OV (90)] were field planted during 2018. These ornamental progenies were evaluated in open field conditions and characterized for their potential use as potted plants, cut flower, cut foliage, or colored minifruits or in landscaping. We observed great variability among the progeny in all the characteristics evaluated, mainly colour (leaves, fruits, rachis, and heart), peduncle orientation and pubescence, fruit position and apex, heart shape, and bract opening. Greater variability was observed for quantitative traits such as plant height, girth, rachis length, flower size, and number of suckers, fruits, hands, leaves, and bracts. Based on quantitative and qualitative traits, 63 novel ornamental hybrids were shortlisted from four crosses [RZ (10), OR (14), OZ (35), and OV (4)] for their potential ornamental use. The shortlisted interspecific ornamental hybrids were also field / glasshouse screened for their reaction to major pest and diseases, and clustered into the following categories of use on the basis of morphological and biochemical parameters.

Potted plants

The interspecific ornamental banana hybrids can be used as potted plants since majority of the hybrids' plant height, pseudostem diameter at collar region and the stalk length were 145 cm, 25 cm and 35 cm, respectively, with minimum number of leaves per plant (≤ 15), fruits per hands (≤ 6), and hands per bunch (≤ 4). Furthermore, presence of other ornamental traits such as attractive leaf and fruit color, bunch position (erect or angled), fruits on the crown (mostly uniseriate instead of biseriate or both), size, shape and color of the bracts and heart gives unique look when grown as potted plants. Because of their shorter height and smaller girth with erect inflorescence, they can be introduced successfully as potted plants in home gardens. They are also shade loving and/or tolerant and grow well at 3000–50000 lux light intensity.

Cut flower

Some hybrids from *M. ornata* $\times$ *M. rubra* and *M. ornata* $\times$ *M. velutina* subsp. *markkuana* crosses were shortlisted because of their upright rachis with fruits pointing upward towards an erect axis (i.e., negatively geotropic), presence of highly attractive,

persistent, and non-revolute persistent bracts, and flowers of inflorescence that last up to 1-3 months. Additional characters such as length of the stalk superior to 20 cm, diameter of the stalk inferior to 4 cm, number of hands per bunch (≤ 4), number of fruits per hand (≤ 6), size and shape of the heart, presence of imbrication, number and opening of floral bracts, and color of the fruits and heart, were also considered for shortlisting the progenies for cut flower purpose.

Cut foliage

For cut foliage, the hybrids with high anthocyanin content (80 to 120 mg/100g FW) in the abaxial side of leaves with eye-catching variegated dark brown stripes on the adaxial leaf side were selected. The leaves can be used for wall decoration, bouquet preparation, or as bioplates with high medicinal value owing to the significant presence of pigments, phenols, and antioxidants.

Landscaping

Unlike their parents, the hybrids from *M. rubra* $\times$ *M. acuminata* subsp. *zebrina*, *M. ornata* $\times$ *M. rubra*, and *M. ornata* $\times$ *M. acuminata* subsp. *zebrina* were found to grow well under open field conditions even in alkaline soil pH (>8.5). Another important characteristic for this category is their tillering capacity with profuse suckering (> 20 suckers within 6 months of planting). All the hybrid progenies were also cold tolerant and can be grown in the northern parts of India. They are also shade loving and hence can be grown under palms and other trees with just 10% of diffused sunlight.

Minifruits

Besides genotypes with appropriate characteristics for landscape plants, potted plants, and floral arrangements, there are several hybrid lines in all the three cross-combinations that produce very small fruits in green and red color that can be used as ornamental plants. These hybrids are characterized by having inflorescences that are erect or at least at the base in the case of colored progenies, with fruit pointing toward the bunch apex and well-spaced between the hands. These hybrids also typically have relatively fewer fruits and are best known for their green or red colored fruits with brightly colored bracts, a feature that makes them popular as ornamental plants. The banana minifruits for floral arrangements are a novelty, mainly due to their originality, representing an innovation for the flower and ornamental plant market, but they have not been commercially explored.

The shortlisted novel ornamental hybrids (63 nos.) from the four crosses were supplied to ICAR-IOPR, New Delhi Municipal Council gardens, and a few State Agricultural Universities (TNAU, Coimbatore; UHS, Bagalkot; AAU, Gujarat and Dr.YSR HU, Venkataramannagudem). Additionally, 12 unique inter-specific ornamental hybrids were also supplied to 10 Centres of ICAR-AICRP on Floriculture for multi-location evaluation. Furthermore, unique interspecific ornamental hybrids were also supplied to ICAR-Krishi Vigyan Kendra, Kollam, to conduct an OFT (On Farm Testing) in 10 farmers' fields for the "Assessment of ornamental banana hybrids in Kollam district of Kerala."

*Musa rubra**Musa ornata**Musa velutina*

Ornamental banana species



Display of diversity of flowers of ornamental banana hybrids developed at ICAR-NRCB



Display of leaves of ornamental banana hybrids developed at ICAR-NRCB

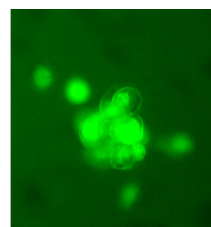
RESEARCH HIGHLIGHTS

CROP IMPROVEMENT

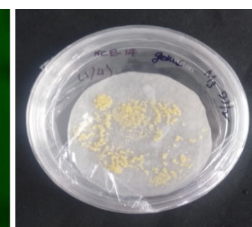
- An exclusive gene bank for crop wild relatives of *Musa* with 56 accessions has been established at the Centre, the first of its kind in India.
- Two improved genetic stocks were registered and IC numbers for 14 ornamental banana hybrids and one dwarf clone of cv. Grand Nain obtained from ICAR-NBPGR, New Delhi.
- A micropropagation protocol has been standardized for Kaveri Kanchan using Somatic Embryogenesis Regeneration Vessel (SERV) bioreactor for both ECS and shoot tip explants. A protocol has been standardized for the storage and easy transport of germinated somatic embryos.



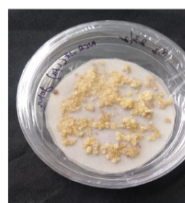
ECS of NCR 17



FDA Staining



MA3 Medium



Embryogenesis stage



Regeneration

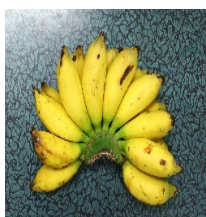


Plant developmental stage



Primary Hardening

Micropropagation protocol for new variety Kaveri Kanchan using ECS



Fruits of Carotenoid rich Kothia based Progeny 932

- Promising hybrid progenies have been identified in evaluation trials. Progeny 932 is an open pollinated diploid progeny of P0480 (Kothia x Calcutta 4) that produced higher provitamin A

content (156µg of PVA /g of dry weight) than their parents.

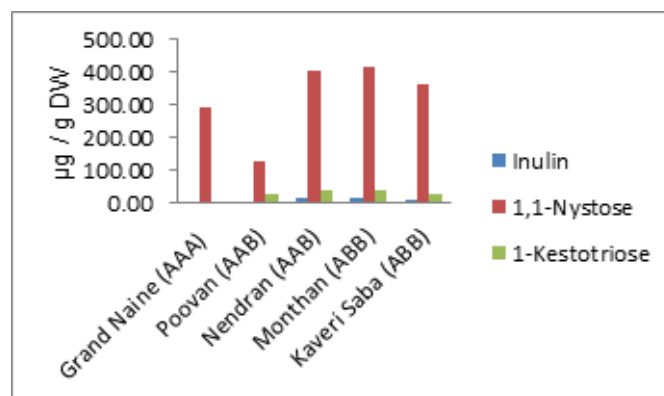
- Based on screening, 12 Fusarium wilt race 1 resistant hybrid progenies have been identified including two Matti x Cv.Rose based progenies (P0213 and P0207), four Kothia based progenies (P0528, P0538, P0567 and P0515), one Saba x Pisang Lilin based progeny (Pro. 684; IC 0642858), and five Pisang Awak based progenies.
- NRCB selection 18 (Progeny No. 959) was found to be a stable performer with an average yield of 23.5kg/bunch for three consecutive years and it has better cooking qualities than Kaveri Saba and Monthan in terms of swelling power, water and oil holding capacity and solubility.
- GC-MS profiling of Ney Poovan and its tetraploid variant led to the identification of volatile compounds common and unique to diploid and tetraploid and their biological functions have been defined and correlated with resistance to biotic stresses like corm weevil and pseudostem borer.
- SSR panel developed for use in DNA fingerprinting has been validated in 25 commercial varieties.
- Genic SSR marker (Ant-FH-SSR11), identified from F35H-1 gene present in the anthocyanin pathway, is able to differentiate the purple and green parents of ornamental bananas and their progenies. The marker is likely to hasten the ornamental banana breeding cycle. The same could be used for distinguishing Red banana and its green variants and hence could be used in clonal fidelity testing of Red banana.
- Guide RNA of Ma10_g00550 was cloned in pRGE31 and confirmed through sequencing and further mobilized into *Agrobacterium tumefaciens* strain for use in ECS transformation towards the development of wilt Foc race 1 resistance through gene editing approach.
- A MusaRgene database has been developed for use as a primary resource of information on R genes from bananas and their relatives. R genes from other allele mining studies are also incorporated which will enable the identification of their homologues in related *Musa* spp.

CROP PRODUCTION AND POST-HARVEST TECHNOLOGY

- Nutrient dynamics in cvs. Nendran and Grand Nain were worked out. In both cultivars, vermicomposting of residues after harvesting reduced the C/N ratio from 60/1 to 9/1 with a recovery of about 58.5% of N, 56.7% of P and

47.5% of K.

- In Ney Poovan, application of organic fertilizers (poultry manure @ 5 kg/pl + groundnut cake @ 1kg/pl + rural compost @ 3 kg/pl + wood ash @ 3 kg/pl) recorded the highest average bunch weight (9.9 kg), which was on a par with that of 100% inorganic fertilizer alone.
- Agro-techniques were standardized for newly released varieties viz., Kaveri Saba, Kaveri Haritha and Kaveri Kalki and ornamental banana hybrids.
- Clump management technology was also standardized for enhancing productivity in Ney Poovan and Kaveri Saba.
- In field evaluation, drought stress in floral primordial stage resulted in delay in flowering in AAA, AAB and ABB genotypes compared to irrigated control with variations. Among AAA genotypes, Lacatan showed delayed flowering by 70 days, while Bharath Moni and Tulsi Manohar recorded earlier flowering compared to irrigated control. In almost all AAB genotypes, the number of days to flowering was prolonged under drought stress except Octoman, Desi kadali, and Agni Malbhog.
- Bunch spray of 2,4-D at 30 ppm along with Brassinolides (2 ppm) in cv. Nendran recorded significant increase in fruit length (24.52%) and there was 8% increase at lower dosages of 10 ppm and 20 ppm.



Fructans type in rhizome of some commercial banana cultivars

- The total fructan content and fructan types of fruit pulp of nine commercial cultivars and rhizomes of five cultivars were analyzed and varying contents of fructan types were found in the pulp with Monthan (ABB) and Nendran (AAB) having the highest amount of inulin-type fructans and Grand Nain possessed 1-kestotriose as predominant fructan.
- Kaveri Saba and Monthan leaves had highest α-tocopherol of 6.4 and 6.2 mg/g respectively,

followed by Grand Nain (5.9 mg/g) and lowest contents were detected in Nendran and Rasthali (4.23 mg/g).

- Pre- and post-harvest techniques for leaf production in banana were standardized for popular varieties like Karpuravalli, Sakkai, Poovan, Progeny 183, and Naadu based on monthly production and in different combinations of mother plant + daughter suckers.
- Cold storage (13.5°C) of Red banana extended the shelf life by up to 23 days with improved quality and sensory attributes. Smart packaging-based ripening indicator label for red banana was fabricated using ammonium molybdate with starch matrix and plasticizers and based on color change, extent of banana ripening could be assessed.
- Encapsulation of β -carotene in protein-modified starch complex was attempted and modified banana starch was found to be a better carrier material than gum acacia, which is commercially used as an encapsulation material next to maltodextrin. Effect of different additives on the structural characteristics of banana starch-based bioplastic films was done.

CROP PROTECTION

- The invasive Bondar's nesting whitefly (*Paraleyrodes bondari*) was found to be present on banana at very low levels. *Eupterote orientalis*, *Artaxa guttata*, and *Miltochrista violacea* were recorded as banana pests for the first time. Severe foliar damage due to vegetable grasshopper, *Atractomorpha crenulata*, was observed in the early stage (3-4 month-old-crop) on cv. Ney Poovan, Nendran, Saba and Karpuravalli.
- Fipronil, cartap hydrochloride and spinosad were found to be the most effective candidates for use against pseudostem weevil. Entomofungal pathogens *Beauveria brongniartii* 27, *B. bassiana* 22, *M. anisopliae* 50 and *B. brongniartii* 28 were found to cause significantly high mortality of pseudostem weevil in laboratory bioassays.
- Biocontrol consortia, viz. endophytic *Bacillus flexus* (Tvpr1) + Rhizospheric *T. asperellum* (NRCB3) and endophytic *Bacillus subtilis* ssp. *inaquosorum* (BS30) + rhizospheric *Bacillus haynesii* (BS17) were found effective for the management of Fusarium wilt disease (TR4) on cv. Grand Nain at Falka block, Katihar District, Bihar.
- Endophytic *Bacillus subtilis* ssp. *inaquosorum* (BS30) + Rhizospheric *Bacillus haynesii* (BS17),

Endo. Rhizo. *T. asperellum* (NRCB3) + *Bacillus flexus* (Tvpr1) proved to be potential candidates for management of Fusarium wilt disease, race 1 at Theni, Tamil Nadu.

- Characterization of *Foc* isolates revealed the presence of *Foc* TR-4 and Race 1 in the fields surveyed in Bihar, West Bengal and Uttar Pradesh.
- Four bacterial and five fungal endophytic and rhizospheric microbial isolates were found effective against *Foc* TR-4. In further evaluation of various combinations under glasshouse conditions in cv. Grand Nain, Rhizo. *Trichoderma* sp. + Rhizo. *Trichoderma asperellum* suppressed Fusarium wilt. Among bacterial combinations, endo. *Bacillus subtilis* + rhizo. *Bacillus subtilis* combination was most effective against Fusarium wilt. Liquid formulation of Endo. *Bacillus subtilis* ssp. *inaquosorum* (BS30) + Rhizo. *Bacillus haynesii* (BS17) resulted in complete suppression of *Foc* TR-4.



Fusarium alone Endo. *Bacillus subtilis* ssp. *inaquosorum* (BS30) + rhizo. *Bacillus haynesii* (BS17)

Validation of liquid formulation of bacterial bioagents for the management of Fusarium wilt Tropical race 4

- Based on 16s rDNA sequencing, PGPR isolates H7BC2 (OM188392.1), H8BC1 (OM188390.1), H6BC3 (OM188389.1), H4BC1 (OM188387.1) and H8BC2 (OM188391.1) were characterized as *Priestia aryabhatai* while H6BC2 (OM188388.1) was characterized as *P. megaterium*. Copper hydroxide (0.1-0.3%) was effective against all *Pectobacterium* isolates and specific *Klebsiella variicola* (1-1B-3) isolate while COC (0.2%) recorded significant inhibition of all *K. variicola* isolates and certain isolates of *Pectobacterium* sp.
- Re-emergence of infectious chlorosis caused by CMV in TC plants in an epidemic proportion was recorded in Jalgaon District, Maharashtra (0-33.88%) and Burhanpur district, Madhya Pradesh (0-100%). The complete genome of CMV isolates infecting banana from Jalgaon and Burhanpur was sequenced and characterized and grouped into subgroup IB.
- Under time course studies, more than 70 major volatile organic compounds (VOC) were identified in BBTV-infected and healthy banana plants. Elite BSMYV free high-yielding

TC Poovan plants were supplied to five KVKs and farmers with positive feedback on their performance.

- Immersion of suckers of Nendran in boiling water before planting for 45-60 seconds significantly reduced the nematode population and root galls and root knot nematodes were also completely absent.
- Parental lines Matti, Namarai, Cultivar Rose, Pisang Jajee and Lairawak and elite mutants TBM 9 and Grand Nain Mutant 1 were found susceptible to root lesion nematode, *Pratylenchus coffeae*.
- Totally 110 ITC accessions were evaluated against Foc R1 (VCG 0124) under glasshouse conditions

and eight resistant, 58 moderately resistant, 32 susceptible and 12 highly susceptible accessions identified. Cardaba-ABB (0394), PC-1205-AAAB (1260), Paka -AA (1254), FHIA-23-AAA (1265), FHIA-02-AAAB (0505), Williams-AAA (0570), TjauLagada -AA (0090) and GCTCV-119 -AAA (1282) were resistant. In field screening at Muthalapuram, Theni, Tamil Nadu also, all these ITC accessions except Cardaba were resistant to Foc R1.

- The recombinant coat proteins of BBrMV and CMV were expressed in bacterial expression systems and are utilized for large-scale production of monoclonal antibodies using the hybridoma technology.

OTHER INFORMATION

ICAR-NRCB and Alliance Bioversity International-CIAT organized an International workshop on 'Phenotyping for Drought Tolerance'

ICAR-National Research Centre for Banana (ICAR-NRCB), Tiruchirappalli and Alliance Bioversity International - International Center for Tropical Agriculture (CIAT), Italy, jointly organized an International workshop on 'Phenotyping for Drought Tolerance' at the Centre during 7-11 March, 2023. In the inaugural session, Dr. A.K. Singh, Deputy Director General (Horticulture Science), ICAR, New Delhi was the Chief Guest and Dr. Sebastien Carpentier, Senior Scientist, Alliance Bioversity International-CIAT was the Guest of Honor. This training program was designed to train researchers in scientific identification of crop genotypes showing drought tolerance under field conditions. A total of 18 researchers from France,

Belgium, Indonesia, Sri Lanka, Papua New Guinea, The Philippines and India have participated. In the valedictory function held on 10 March, 2023, Dr. V.B. Patel, Assistant Director General (Horticulture Science-II), ICAR, New Delhi, participated as Chief Guest and stressed the importance of the release of cultivars with improved resistance to drought conditions and high yield stability to ensure food security in the 21st century. In his presidential address, Dr. R. Selvarajan, Director ICAR-NRCB underlined the importance of the training on field identification of drought tolerant cultivars of banana and other crops in the face of challenges faced by farmers cultivating in water deficit areas and the potential for introduction of drought tolerant selections, hybrids etc. Dr. I. Ravi, Course Director of the program explained the importance of phenotyping in the era of water deficit and briefed about the impact of the training program and the feedback from the participants.



Dr. R. Selvarajan, Director, ICAR-NRCB and trainees of International workshop on 'Phenotyping for Drought Tolerance' held at the Centre during 7-11 March, 2023

ICAR-NRCB and APEDA jointly organized a Consultative Workshop on Export of GI and traditional bananas

ICAR-National Research Centre for Banana, Tiruchirappalli and Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi, jointly organized a two-day Consultative Workshop on 'Export of GI and traditional bananas: Present scenario, trade opportunities and way forward' during 21-22 December, 2022.

Dr. M. Angamuthu, IAS, Chairman, APEDA, New Delhi, was the Chief Guest of the inaugural session and Mr. C. Samayamoorthy, IAS, Agricultural Production Commissioner, Agriculture and Farmers Welfare & Secretary to Government of Tamil Nadu graced the occasion as Special Guest. Ms. Rajalakshmi Devaraj, IAS, Addl. DGFT, Chennai; Dr. V. Geethalakshmi, Vice Chancellor, TNAU, Coimbatore and Dr. K.M. Indires, Vice-Chancellor, UHS, Bagalkot; and Dr. V.B. Patel, ADG (Horticultural Science-II), ICAR, New Delhi,

were the Guests of Honour. The inaugural session was presided over by Dr. R. Selvarajan, Director, ICAR-NRCB, Tiruchirappalli. On the occasion, six publications were released and three awards were distributed to banana FPO's / technology disseminators for conservation of GI bananas. More than 300 participants attended the export workshop and an exhibition was also organized wherein more than 100 varieties and land races of banana bunches and fruits were displayed.

The consultative workshop was conducted in three technical sessions in two days. There were 30 keynote lectures delivered by experts of banana export, supply chain management, government policies, marketing and PPV & FRA. The plenary session of the workshop was held on 22 December, 2022. Dr. M.K. Shanmugasundaram, IAS, Development Commissioner, MEPZ, SEZ, Chennai was the Chief Guest and Dr. Dinesh Kumar Agarwal, Registrar General, PPV & FRA, New Delhi and Mr. Alex Paul Menon, IAS, Joint Development Commissioner, MEPZ, SEZ, Chennai were the Guests of Honor.



Dr. R. Selvarajan, Director, ICAR-NRCB explains diversity of banana to Chief Guest, Dr. M. Angamuthu, IAS, Chairman, APEDA, New Delhi and Dr. V. Geethalakshmi, Vice Chancellor, TNAU, Coimbatore during the National level workshop on export of GI and traditional bananas



Release of Publications during the National level workshop on export of GI and traditional bananas

ICAR-NRCB Foundation Day & Kisan Mela

ICAR-National Research Centre for Banana, Tiruchirappalli celebrated its 29th Foundation Day cum *Kisan Mela* on 20 August, 2022. Dr. (Smt.) Poonam Malakondaiah, IAS, Chief Commissioner & Special Secretary to Government of Andhra Pradesh, graced the occasion as Chief Guest. Dr. (Ms.) R. Brindha Devi, IAS, Director, Horticulture & Plantation Crops / Managing Director, TANHODA was the Special Guest. Dr. Anitha Karun, Director, ICAR-CPCRI, Kasaragod, Dr. Debi Sharma, ICAR-IIHR, Bengaluru and Dr. Murugesu Boopathy,

Former Vice Chancellor, TNAU, Coimbatore were the Guests of Honour. The event was presided over by Dr. S. Uma, Director, ICAR-NRCB, Tiruchirappalli. During the inaugural session, publications on value added products of banana, Agribusiness Incubation Centre, nutritive values of banana flower and Government schemes for banana farmers were released. Prizes for best banana farmers, entrepreneurs and banana germplasm conservation were distributed. On the occasion, two technical presentations were made under the theme 'Advances in Production, Post-Harvest Technologies and Value Addition in Banana'.



ICAR-NRCB celebrates its 29th Foundation day and *Kisan Mela* on 20 August, 2022

23rd RAC meet of ICAR-NRCB

The 23rd Research Advisory Committee meet of the Centre was held during 14-15 February, 2023. The RAC meet commenced with a welcome address by Dr. R. Selvarajan, Director, ICAR-NRCB. He presented the salient achievements made under various research programs during the past one year. Salient achievements under various research projects in Crop Improvement, Crop

Production and Post-harvest Technology and Crop Protection were presented by the scientists. The RAC chairman and members had an elaborate discussion on the progress made under various projects, shortcomings and ways for further improvement. The Chairman and members of RAC visited the research farm of ICAR-NRCB on 15 February, 2023 and reviewed the ongoing field experiments under various projects.



Chairman and members of RAC with Director and scientific staff of ICAR-NRCB during 23rd RAC meet

ICAR-NRCB celebrates National Science Day

ICAR–National Research Centre for Banana, Tiruchirappalli celebrated ‘National Science Day’ on 28 February, 2023 under the theme ‘Global Science for Global Well-being’. On the occasion, the institute organized an ‘Open Day’ for students, farmers and general public. The mega event was organized by the staff of ICAR-NRCB under the chairmanship of Dr. R. Selvarajan, Director, ICAR-NRCB. Dr. C. Vanniarajan, Dean, Anbil Dharmalingam Agricultural College and Research Institute (TNAU), Tiruchirappalli, graced the inaugural session as Chief Guest. Dr. P. Paramaguru, Horticultural College and Research Institute for Women (TNAU), Tiruchirappalli, and Professor S. Jayasankar, University of Guelph, Canada, were the Guests of Honour. During the inaugural session, Professor S. Jayasankar gave a guest lecture to the visiting college students. The visitors were briefed about the various

technologies developed in Improvement, Production, Post-Harvest Technology and Protection sections by the scientific and technical staff of ICAR-NRCB by showcasing samples, specimens, equipment, etc. The visitors were also informed about the institute technologies through audio-visual presentations and an exhibition. Fruits of banana including ICAR-NRCB developed cultivars, popular cultivars, land races and wild germplasm lines were displayed. The visitors were also taken to the ICAR-NRCB farm where Post-Harvest machineries and banana field gene bank were showcased. With 370 germplasm accessions collected from India and abroad, ICAR-NRCB maintains ‘Asia’s largest field gene bank for banana’. The visitors were explained about the diversity of banana germplasm and importance of field gene bank in banana breeding program. Around 2000 students from different schools and colleges located in and around Tiruchirappalli district and more than 1000 banana farmers attended the event.



Visitors at ICAR-NRCB during ‘National Science Day’ on 28 February, 2023

Drone Technology Demonstration

ICAR-NRCB initiated the use of drone for enhancing the production and productivity of banana. Under pilot project mode, drones were employed to spray fungicides and banana shakti – A micronutrient mixture of NRCB. An awareness meeting cum demonstration of drone technology for application of fungicide for the management

of leaf spot disease was organized for the farmers at Thirukurungudi, Kalakkad, Tirunelveli District, Tamil Nadu on 9 January, 2023. In collaboration with Thottiyam Banana Producers Group, an awareness campaign cum demonstration of drone technology for application of banana shakti was conducted at Varadarajapuram, Thottiyam, Tiruchirappalli, Tamil Nadu on 31 January, 2023.



Demonstration of Drone technology to farmers

ICAR-NRCB and MANAGE conduct training program on 'Agripreneurship on banana based technologies'

ICAR-National Research Centre for Banana, Tiruchirappalli joined hands with National Institute of Agricultural Extension Management (MANAGE), Hyderabad and organized an online training program titled 'Agripreneurship through banana-based technologies – An avenue for *Atmanirbhar*

Bharat' from 15 to 17 June, 2022. This training program aimed to give an opportunity to farmers, entrepreneurs, officials of KVK and SAU about technologies that are developed at NRCB and entrepreneurial principles, procedures and processes for establishing a successful agribusiness start-up. Around 100 trainees attended the training program and got benefitted.



Trainees of High-end workshop along with Scientists of ICAR-NRCB and Chief Guest Dr.Nicolas Roux, Team Leader, Bioversity International, France

High-End workshop for research scholars

ICAR-National Research Centre for Banana, Tiruchirappalli, organized a 'High-End Workshop (*Karyashala*)' on 'Recent advances in banana improvement, production, protection, PHT, extension, and business arena for nutritional security in the era of *Atmanirbhar Bharat*' during 17–26 September, 2022, funded by DST-SERB. The workshop was specifically designed for Postgraduate students and Ph.D.scholars with the objective to expose them to contemporary technological advancements in banana crop production. Totally 31M.Sc. and Ph.D. research scholars from six states of the country attended the workshop.

Anti-Terrorism Day

ICAR-NRCB observed the 'Anti-Terrorism Day' on 21 May, 2022 with an objective to **wean away the youth from terrorism and the cult of violence**. On the occasion, the staff of the centre took an 'Anti-terrorism pledge'.

International Yoga Day celebration

The Eighth International Yoga Day was celebrated at ICAR-NRCB on 21 June, 2022. On the occasion, Mr. T. Navaneetha Krishnan, PG Diploma (Yoga), M.Sc. (Yoga), delivered a guest lecture and gave training in doing different '*asanas*'.



Staff of ICAR-NRCB celebrates International Yoga Day by practicing different '*asanas*'

ICAR South Zone Sports Meet 2022

ICAR Sports Meet, 2022 for South zone was held in Hyderabad during 22-25 November, 2022.

The staff of ICAR-NRCB actively participated in the sports event with its largest contingent ever, including women contingents for the first time.



Team NRCB at ICAR Sports Meet 2022 for South zone held in Hyderabad during 22-25 November, 2022



Dr. R. Selvarajan, Director, ICAR-NRCB was felicitated by Indian Phytopathological Society at National Symposium on Plant and Soil Health Management: Issues and Innovations' held at University of Mysore, Mysuru, Karnataka during 21-23 February, 2023



ICAR-NRCB Received "Best Stall Award" at National Horticulture Fair-2023 held at ICAR-IIHR, Bengaluru during 22-25 February, 2023

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