

ICAR - NRCB

Newsletter

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ICAR - National Research Centre for Banana

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DIRECTOR'S DESK

Greetings.

Since April 2020, the world and India have been facing the scourge of the deadly Covid-19 pandemic, which has affected the economy and all spheres of life. At this juncture, ICAR-National Research Centre for Banana, Trichy has been striving hard to meet the demands of banana farmers and other stakeholders despite the covid-related restrictions and constraints. In this issue of NRCB newsletter for the period April, 2020 - March, 2021 a detailed review of 'Rhizome rot disease: A major threat to banana cultivation' is presented 'In Focus'. Despite the lockdown, the institute has achieved remarkable research milestones during 2020-21. In the Crop Improvement section, hybrid progenies of different parental crosses were evaluated and progenies no. 913, 940, 943 and 434 were found to be promising with respect to bunch yield and carotenoid content. Nendran based hybrid, NCR 17, performed well under ART at two locations. Our intensive screening efforts to identify sources of resistance to fusarium wilt have led to the identification of 34 ITC accessions resistant to Fusarium wilt (Foc) Race 1 under sick plot conditions and few hybrid progenies were identified as immune to Foc Race 1. Mutation breeding for Foc resistance has also yielded a few promising mutant lines and these are under mass multiplication for further evaluation. Candidate resistant genes have been identified which are up-regulated upon Foc TR4 infection and genic SSR markers were identified for Foc Race 1 and TR4. One hybrid was found resistant to root-lesion nematode, *Pratylenchus coffeae*. In Crop Production Section,



nutrient dynamics studies were accomplished for cvs. Nendran and Grand Naine.

In clump management studies, effect of number of suckers on crop cycle, fertilizer application on growth and yield was elucidated for cvs. Ney Poovan and Poovan. Few drought tolerant ABB cultivars were identified. Flavonoid compounds from the fruit peel and anthocyanidin compounds from the flower bracts of different cultivars were identified and quantified. Microencapsulation of anthocyanin compounds was attempted and analyzed. In Post-Harvest Management, cultivars and season suitable for maximum leaf production were determined. Value added products like pizza, banana powder, low calorie stem juice, fruit syrup, pulp yogurt and edible cutlery were prepared and evaluated.

In Crop Protection Section, the bagworm, *Manatha albipes* was identified as a major pest of banana for the first time. Fall armyworm, *Spodoptera frugiperda*, an alien invasive pest in India, was found to affect banana in Tamil Nadu and Kerala. Many hitherto unknown natural enemies of banana pests were identified and documented. A rapid, reliable screening protocol for root-lesion nematode, *Pratylenchus coffeae* was developed and validated. Race-specific primers to differentiate the races of Fusarium wilt and a novel, rapid, accurate and cost-effective technique for detecting FocTR4 were developed. Promising biocontrol agents for use against Foc and PGPR isolates are under evaluation. Outbreak of Cucumber Mosaic Virus and Banana Bract Mosaic Virus was reported from Maharashtra. Gene expression of BBTv, resistance to viruses, and virus-vector relationships were studied at the molecular level.

During 2020-21, the Centre signed MoA with Andhra Pradesh Food Processing Society,

Govt. of Andhra Pradesh; Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram; National Design and Research Forum, Bangalore; Dr. YSR Horticultural University, Andhra Pradesh and K. Ramakrishnan College of Technology, Tiruchirappalli. During the lockdown, ICAR-NRCB organised a series of eight webinars covering all facets of banana production with lectures from experts for the benefit of stakeholders. Scientists of the centre participated in various virtual meets and trainings and shared their expertise. The Institute actively took part in social service to mitigate the impact of Covid-19 on the vulnerable sections by distributing relief material. The staff of ICAR-NRCB contributed a day's salary to the PM-CARES fund. The institute also distributed 7000 banana fruits to 2700 sanitary workers in Trichy Corporation. To facilitate rapid testing of COVID-19 samples, ICAR-NRCB handed over an advanced version of RT-PCR machine to the Government Hospital, Tiruchirappalli. The Centre felicitated the doctors of Tiruchirappalli during the Independence Day celebrations for their selfless and untiring service.

center

IN FOCUS

Rhizome rot disease: A major threat to banana cultivation

Status of rhizome rot disease

Rhizome rot disease is one of the major problems in banana (*Musa* spp.) cultivation worldwide. The disease is also known by different names such as soft rot, head rot, tip over and pseudostem wet rot. Incidence is reported to be as high as 40-70% in severely infected fields. In India, it is a major problem during the early stages of establishment as it causes germination failure and death of the plants in different commercial varieties including Cavendish group of bananas. Roving surveys were conducted from 2017 to 2019 to characterize the pathogens causing rhizome rot in different banana growing states of India, viz., Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal which account for 6.073 lakh ha area under banana cultivation. During the surveys, the disease was observed in important commercial cultivars such as Grand Naine (AAA), Thellachakkarakeli (AAA), Karpurachakkarakeli (AAB), Poovan (AAB) and Ney Poovan (AB), and the disease incidence ranged from 5 to 30% (Table 1 & Fig. 1). The tissue culture (TC) plants had comparatively greater incidence of rhizome rot than sucker derived plants.

Table 1. Status of rhizome rot disease in certain banana growing regions of India

Location	Cultivar (Planting material)	Incidence (%)
Tamil Nadu		
Lalgudi (Tiruchirappalli)	Poovan (Suckers)	3.9
	Ney Poovan (Suckers)	6.3
Koppu (Tiruchirappalli)	Ney Poovan (Suckers)	2.5
	Nendran (Suckers)	6.3
Thottiyam (Tiruchirappalli)	Ney Poovan (Suckers)	10-15
NRCB farm (Tiruchirappalli)	Grand Naine (Suckers)	3.8
Nachalur (Karur)	Grand Naine (TC)	20-30
Andhra Pradesh		
Anantapur	Grand Naine (TC)	10-20
Kovvur (West Godavari)	Karpurachakkarakeli (Suckers)	10-15
Pulidindi (East Godavari)	Tellachakkarakeli (Sucker)	5-8
Karnataka (Chikkabalapura)	Ney Poovan (Suckers)	8.0
	Grand Naine (Suckers)	3.6
West Bengal (Chinsurah)	Champa (Poovan type)	1-3
Uttar Pradesh (Maharajganj)	Grand Naine (TC)	5-12
Bihar (Katihar)	Grand Naine (TC)	3-5



Fig. 1. Field view of rhizome rot affected plants (cv. Grand Naine)

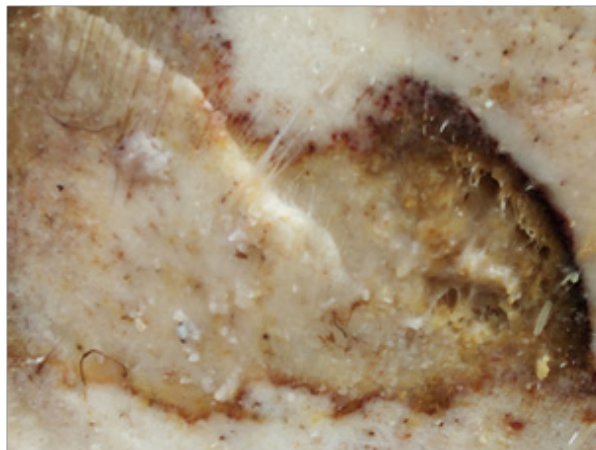


Fig. 2. Cross section of corm affected by rhizome rot

Symptoms

The disease weakens the rhizome or corm. The affected young plants show yellowing of leaves and necrotic drying with or without heart rot. When the infected rhizome is cut open, yellow or brown coloured, water soaked big spots with dark brown irregular margin can be seen (Fig. 2). Severely infected rhizomes may have characteristic symptoms such as decay of corm tissues, cavity formation and brown ooze with foul smell. Severely affected plants may topple down at later stages.

Characterization of the pathogen

Soft rot disease is caused by a variety of bacterial pathogens and among them, *Pectobacterium carotovorum* (earlier known as *Erwinia carotovora* ssp. *carotovora*), *Dickeya* sp. (also known as *E. chrysanthemi* and *P. chrysanthemi*), *D. paradisiaca* (previously known as *E. chrysanthemi* pv. *paradisiaca*) and *D. zea* have been reported as major causal agents elsewhere. In India, *P. carotovorum* (*E. carotovora* ssp. *carotovora*) or *Dickeya* sp. (*E. chrysanthemi*) or both are reported as causal agents of the rot. As these bacterial species are good pectin degraders (i.e., they produce pectinases which degrade pectin), for isolation of such pathogens normally Crystal Violet Pectate (CVP) medium is employed. In our study, we attempted to isolate rhizome rot pathogens from infected samples collected from different parts of India by using CVP medium and in most of the samples, the bacterial colonies were formed on CVP with pectin utilization markings (Fig. 3). However, three samples collected from cvs. Ney Poovan (Kulithalai, Kulithalai District, Tamil Nadu), Grand Naine (Thayanur, Tiruchirappalli district, Tamil Nadu) and Thellachakkarakeli (Pulitindi, East-Godavari district, Andhra Pradesh), did not yield any bacteria. However, these samples produced whitish to dull white, mucoid, raised, round and translucent

colonies when plated on nutrient agar (Fig. 4) and these isolates were named as NPK-3-48, GTC-5 and 1-1B-3, respectively. As these colonies were found unique compared to colonies obtained on CVP (which were analyzed and confirmed separately as *Pectobacterium* spp.), they were further characterized by pathogenicity tests and by biochemical and molecular methods.

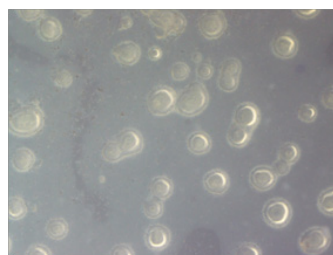


Fig. 3. *Pectobacterium* colonies on CVP medium

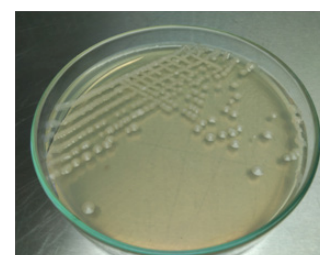


Fig. 4. *Klebsiella variicola* colonies on NA medium

For pathogenicity test, bacterial cells of these three isolates were inoculated into the rhizome of three-month old tissue cultured banana (cv. Grand Naine) at soil level and the inoculated plants were maintained in a glasshouse at 32 ± 2 °C. After 30-35 days of inoculation, rhizome rot symptoms appeared in plants inoculated with the bacterial isolates, viz., NPK-3-48, GTC-5 and 1-1B-3 and no rhizome rot symptoms were observed in control. Koch's postulate was proved by re-isolation and identification. For molecular analysis, 16S rDNA gene of these three isolates was amplified using universal primers 27F (5'-AGAGTTTGATCCTGGCTCAG-3') and 1492 R (5'-GGTTACCTTGTTACGACTT-3') and the resultant single amplicon was sequenced and the sequences were submitted in NCBI (Accession Nos. MW036529; MW036530; MW036531). The BLAST searches of these sequences with NCBI database showed 99.79-99.86% sequence similarity with *Klebsiella variicola* (GenBank Accession No: NR_025635.1) and phylogenetic analysis also indicated that these three isolates were recovered along with the same clade of *K. variicola* isolates

reported elsewhere and out grouped with *K. oxytoca* (Fig. 5). The study indicates that besides *Pectobacterium*, *K. variicola* also causes rhizome rot disease in banana in India.

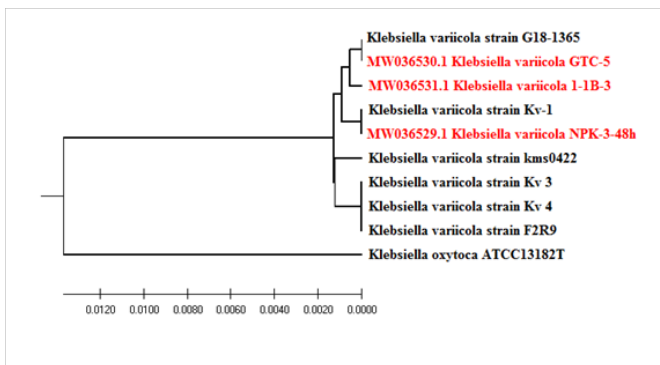


Fig. 5. Phylogenetic analysis of 16SrRNA genes of *Klebsiella variicola* strain from different host crops (A phylogenetic tree constructed from the 16SrRNA gene sequence of different *Klebsiella variicola* strains. The strains obtained from banana were highlighted in red. The tree was rooted with *K. oxytoca*. The evolutionary history was studied using UPGMA method with 500 bootstraps in Mega X).

The pathogenicity test for rhizome rot by standard method takes nearly two months and hence, ICAR-NRCB has developed a rapid pathogenicity assay unit for regulating soil temperature and by using this unit the test could be completed within 15 days.

Management of rhizome rot disease

Management practices recommended for rhizome rot include planting of healthy suckers, drenching with *Pseudomonas fluorescens* @ 1-2 lit per plant (50 g/l of water) at 0th+2nd+ 4th+6th month after planting and growing sunnhemp in interspaces for 2-3 times till the 5th month after planting or applying bleaching powder @ 6 g/plant (at 0th+1st+2nd+3rd+4th month after planting) and growing sunn hemp in the interspaces for 2-3 times till 5 months after planting. To develop sustainable eco-friendly management measures, ICAR-NRCB has isolated and identified effective Plant Growth Promoting Rhizobacteria (PGPR) isolates such *Bacillus aryabhatai* and *B. wiedmannii* which showed significant growth promotion. Besides, 30 Actinobacterial isolates were also isolated for inclusion in management trials against rhizome rot of banana. As PGPR and Actinobacteria are effective for the management of bacterial diseases, attempts are being made for the development of effective consortia formulations for the management of rhizome rot.

RESEARCH HIGHLIGHTS

Crop Improvement

- Morpho-taxonomic characterization has been completed for 217 accessions at TNAU, Coimbatore as a part of ICAR-AICRP (Fruits), using IPGRI *Musa* descriptor. DNA fingerprints have been developed for NRCB released varieties using SCoT markers.
- Performance of cv. Ney Poovan derived from different explants, namely shoot tip, male flower bud and cormlet, was evaluated and plants derived from shoot tip were the best with respect to yield and crop duration.
- A prototype has been developed for the preparation of synthetic seeds from somatic embryos @ 210-360 synthetic seeds per minute and 90-95% germination was observed in synthetic seeds.
- Calcutta 4 was found to be the best compatible male parent for Poovan (ABB) as it produced parthenocarpic progenies. Pisang Lilin was found to be the best male parent for Kaveri Saba (ABB), as they produce parthenocarpic bunches with good cooking quality.
- Progeny No. 434 (Udhayam x Chengdawt) yielded 15 kg bunch weight and was found to be superior with long shelf life (12 days) and high carotenoid content (93.62 µg/gDW) which was 14-fold greater than Grand Naine (4 µg/gDW).



Progeny No. 434 (Udhayam x Chengdawt)

- Adaptive research trials for NCR 17 along with the other Nendran based hybrids have been conducted at two locations, Udumalaipettai and Coimbatore, Tamil Nadu which exhibited high standard heterosis.
- Sixty-three inter-specific ornamental banana hybrids were shortlisted out of 362 based on the attractive colour of the pseudostem, foliage, fruits and bracts.
- Progeny No. 15 (Sanna Chenkadali x Lairawk), 97 (Pisang Jajee x Matti), 426 (*Musa ornata* x *M. ac. burmannica*), 428 (cv. Rose x Pisang Lilin),

528 (Kothia x Calcutta – 4), 821 (Udhayam x Pisang Lilin) were found to be immune to *Foc* Race 1 under sick plot conditions.

- NRCBGNM 1 derived from gamma irradiated ECS showing resistance to Race 1 under sick plot conditions was mass multiplied and planted for large scale field evaluation in two hotspots of Tamil Nadu.
- Candidate resistant genes, R2 (CC-NBS-LRR), R3 (LRR-RLP) showed four-fold and R4 (LRR-RLK) showed three-fold up-regulation in resistant cultivars upon *Foc* TR4 infection than the susceptible cultivars. Genic SSR markers associated with *Foc* Race 1 and TR4 were identified and found to differentiate the resistant and susceptible cultivars.

Crop Production and Post-Harvest Technology

- Nutrient dynamics studies were completed in cvs. Nendran and Grand Naine.
- In organic banana farming, combined application of organics including 5kg poultry manure, 1 kg groundnut cake, 3kg rural compost, and 3kg wood ash alone per plant produced 25.3 kg of fruits in cv. Grand Naine.
- In a field experiment, ABB genotypes were evaluated for drought stress tolerance at flowering stage and Bluggoe, Kostha Bontha and Peyan were found tolerant producing normal fruits with yield on par with irrigated treatment.
- Application of silicon (Si) as foliar spray in banana during vegetative growth increased the dry matter production compared to control.
- Cvs. Monthan (ABB) and Kaveri Udhayam (ABB) contained high amounts of gallicocatechin (180 mg/100 g) and antioxidant activity.
- Anthocyanin contents in the flower bracts of ten genotypes from the germplasm bank was estimated and Borkal Baista (BB), Suti Jahaji (AA) and Gobin Tulci contained high quantity of anthocyanins (45-50 mg/100 g).
- Nutraceutical analyses of free and microencapsulated anthocyanins from Grand Naine flower bracts with 84% cyanidins and commercial cyanidin 3-*O*-rutinoside showed

that the microencapsulated anthocyanins showed higher antioxidant activities than free and commercial cyanidin 3-*O*-rutinoside.

- Ripe pulp of Monthan and Nendran contained the highest amount of fructans (186 µg/g).
- Leaf production in cv. Karpuravalli was maximum (6.43) followed by Sakkai (5.96) and Poovan (5.93), respectively.
- Among five varieties tested for *in vitro* starch hydrolysis, Kaveri Saba and Monthan showed low hydrolysis rate due to higher resistant starch.
- Pizza prepared with 10% green banana flour was the most preferred with the highest sensory score.
- Edible cutlery from banana waste and nanocellulose from banana fibre were prepared and a faster method of dewaxing of banana fibre has been standardized.



Bluggoe (ABB) Kostha Bontha (ABB) Peyan (ABB)
Drought tolerant ABB banana genotypes

Crop Protection

- Bagworm, *Manatha albipes* was reported as a pest of banana for the first time and infestation was found on 108 germplasm accessions.
- Fall armyworm, *Spodoptera frugiperda*, an alien invasive pest of maize, was found to feed and complete its lifecycle on banana in Tamil Nadu.
- Severe infestation of eriophyid mite, *Phyllocoptruta musae*, was recorded for the first time on ornamental banana, *Musa laterita*.
- Three highly race-specific primers were designed for detecting Fusarium wilt Race 1, Race 4 and TR4 isolates and validated.

- A Loop-mediated isothermal amplification (LAMP) assay was standardized for the detection of genes specific to *Foc* TR4 and assay conditions were optimized.
- Two phosphate solubilizing bacteria (PSB) isolates, *Enterobacter hormaechei* ssp. *xiangfangensis* (PSB52) and *Leclercia adecarboxylata* (PSB54) were found promising in terms of improved plant growth, available phosphorus and phosphatase enzyme activity.
- Severe outbreak of CMV as high as 11-52.17% and 41.15-75.96% was recorded in Jalgaon, Maharashtra and Burhanpur, Madhya Pradesh respectively, in two successive years (2019 and 2020).
- Primers were designed for amplifying a full-length construct of BBrMV by an overlapping-extension PCR (OE-PCR) to produce infectious cDNA of BBrMV.
- Eleven transgenic lines obtained by RNAi with replicase gene / multiple virus gene construct were challenge inoculated on plants with BBTv in the net house and the plants yielded bunches without expressing any symptoms of bunchy top.
- Field evaluation data on episomal BSMYV free tissue culture derived Poovan plants at seven locations showed significant differences in the growth and yield parameters compared to sucker grown plants and symptoms of streak disease were not expressed in tissue cultured plants at six locations.
- A simple, rapid screening protocol was developed for evaluation of banana genotypes for resistance to root-lesion nematode (*Pratylenchus coffeae*) and validated.
- In pot culture, soil drenching with salicylic acid @ 50 and 100 μ M concentration at 24hrs prior to inoculation on tissue cultured Grand Naine reduced the root population of root-knot nematode (30 and 41%, respectively) and root-lesion nematode (67 and 68%, respectively) over control.



Fall armyworm, *Spodoptera frugiperda* feeding on banana

OTHER INFORMATION

Equipping transgenders for Agri-entrepreneurship – A novel initiative by ICAR-NRCB

The ICAR-NRCB initiated an endeavor “Equipping transgenders for Agri-entrepreneurship” with the objective of “Reaching the un-reached” and imparted two days hands-on training program on “Banana based entrepreneurial avenues for economic empowerment of Transgenders in Trichy district of Tamil Nadu” during 27-28 January, 2021. The program was attended by eight transgender trainees.



Transgender trainees with the Director and other staff of ICAR-NRCB

Moon man of India, Dr. Mylswamy and ICAR-NRCB come together to create a circular economy by using banana waste

A major initiative was launched by ICAR-NRCB in partnership with Dr. Mylswamy Annadurai, Vice President, Tamil Nadu State Council for Science and Technology (TNSCST), Government of Tamil Nadu and Former Director, Indian Space Research Organization (ISRO) by signing an MoA to develop pilot scale machinery for extracting banana fiber and utilize the sap, central stem and scutcher for producing a variety of products. The MoA was signed by ICAR-NRCB, IIIT- DM, Kancheepuram and Industry Gencrest, Mumbai on 10 February, 2021 at ICAR-NRCB, Tiruchirappalli.



Dr. Mylswamy Annadurai, Vice President, TNSCST, Government of Tamil Nadu and Former Director, Indian Space Research Organization (ISRO), Dr. S. Uma, Director, ICAR-NRCB, Scientists and other delegates during signing of MoA

27th Foundation Day & Kisan Mela

ICAR-NRCB celebrated its 27th Foundation Day and Kisan Mela in virtual mode due to the restrictions imposed by Covid-19. Dr. Trilochan Mohapatra, Secretary, DARE & DG, ICAR was the Chief Guest and Dr. A. K. Singh, DDG (Hort. Science), ICAR was the Guest of Honour. The event was felicitated by Drs. N. Kumar, Vice Chancellor, TNAU; Rony Swennen, IITA, Uganda; James Dale, QUT, Australia; Nicholas Roux, Bioversity International-CIAT and K.B. Patil, JISL. During the event, the Chief Guest virtually inaugurated the new facilities at NRCB, *viz.* transgenic net-house, rain-out shelter, gamma chamber and bioreactor facility. The Chief Guest also released new ICAR-NRCB publications and gave away awards to banana farmers and entrepreneurs.

ICAR-NRCB signs MoA with Government of Andhra Pradesh for developing banana value chain

ICAR-NRCB signed a Memorandum of Agreement (MoA) with the Government of Andhra Pradesh for providing new innovative technologies on banana processing and value addition. This agreement ensures development of a knowledge centre at Pulivendala under the AP Food Processing Society (APFPS) and promotion of new micro food processing centres besides capacity building of the entrepreneurs. Dr. A.K. Singh, DDG (Hort. Science), ICAR, New Delhi, and Dr. S. Uma, Director, ICAR-NRCB also participated in the event through virtual platform. The State Minister of Agriculture, Mr. K. KannaBabu; Vice Chairman of AP Agriculture mission, Mr. M.V.S. Nagi Reddy; Special Secretary Food Processing, Mrs. Poonam Malakondiah; Chief Executive Officer, APFPS, Mr. Sridhar Reddy; and officials from the state agriculture and horticulture departments also attended the ceremony.



Scientists of ICAR-NRCB with the Chief Minister, Andhra Pradesh during signing of MoA

ICAR-NRCB's contributions to mitigate the impact of COVID-19

During the COVID-19 crisis, ICAR-NRCB actively took part in social service and contributed to mitigate its impact on the vulnerable sections by distributing relief material. A total of 300kg of banana fruits, 200 bottles of stem juice and 300 banana figs were handed over to the district authorities by Dr. S. Uma, Director, ICAR-NRCB in the presence of scientists and staff. The staff of ICAR-NRCB contributed a day's salary to the PM-CARES fund. The NRCB distributed 10 kg of rice, vegetables, fruits and banana stems to 200 families at the Poolangudi Narikorava Colony near Trichy. Rations were also distributed to stranded North Indian labourers in Kumbakudi area near Mathur and to a home for visually impaired and senior citizens. The institute also distributed around 7000 banana fruits to 2700 sanitary workers in Trichy Corporation which was inaugurated by Mr. Sivasubramaniyan, Commissioner, Trichy Corporation. In order to facilitate rapid testing of COVID-19 samples in Tiruchirappalli, ICAR-NRCB handed over an advanced version of RT-PCR machine to Dr. Vanathi, Department of Microbiology, Govt KAPV Medical College, Tiruchirappalli, on 24 July, 2020. Shri Sivarasu, District Collector, Trichy, appreciated the cooperation extended by the Ministry of Agriculture and Farmers' Welfare, Govt. of India, New Delhi.



Handing over of RT-PCR machine by ICAR-NRCB for COVID-19 diagnosis

Independence Day celebrations

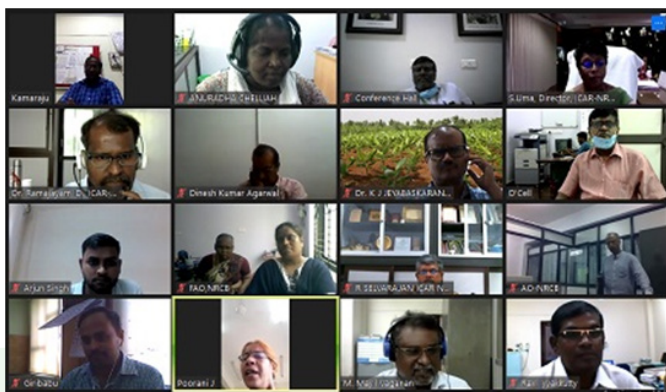
During the Independence Day celebration on 15 August, 2020, ICAR-NRCB appreciated the doctors who worked tirelessly during COVID-19 crisis and honoured Dr. S. Palaniappan, KAPV Govt. Medical College and Dr. Rajesh, KMC Hospital, Tiruchirappalli.



Director, ICAR-NRCB honours doctors of COVID pandemic during Independence Day celebrations

Vigilance Awareness Week

ICAR-NRCB observed the Vigilance Awareness Week during 27 October–2 November, 2020. Staff of the institute took the integrity pledge and elocution and on-spot slogan competitions were held on the theme - “SATARK BHARAT, SAMRIDDH BHARAT (Vigilant India, Prosperous India)”.



Observance of Vigilance Awareness Week in virtual platform

Constitution Day celebrations

The Constitution Day was celebrated on 26 November, 2020 at ICAR–NRCB and the staff of the institute read out the preamble to the constitution.



Staff of ICAR-NRCB reading the preamble of the Constitution during Constitution day

International Women’s Day celebrations

The ICAR-NRCB celebrated the International Women’s Day on 10 March, 2021 with the theme “International Women’s Day: Women Leadership in Agriculture: Entrepreneurship, Equality & Empowerment” to acknowledge the role of women in agriculture and allied sectors and honoured women achievers. Dr. (Mrs.) Nandhini Azad, President, Indian Co-operative Network of Women, Chennai was the Chief Guest of the event and Mrs. Kavin Thirumurugan, Director of Sai Kirupa Group of Institutions, Tirupur; Mrs. D. Nitya, IRS, Joint Commissioner of Income Tax, Trichy; Dr. (Mrs.) S. Kowsalya, Registrar, Avinasilingam Institute, Coimbatore; and Mr. P. Sridharan, Joint Commissioner of Income Tax, Trichy were guests of honour. On the occasion, six women achievers were felicitated for their outstanding achievements and significant contribution towards women empowerment and leadership in the society. A team of Covid warriors from the Department of Microbiology, KAPVGM, was felicitated for its untiring and dedicated service.



Dr. S. Uma, Director, ICAR-NRCB, Chief Guest, Guests of Honour and women achievers at International Women’s Day celebrations

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