



ICAR - NRCB NEWSLETTER

ICAR - National Research Centre for Banana

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DIRECTOR'S DESK

At ICAR-NRCB, one of the main areas of research on Crop Production and Post Harvest Technology Section is pre and post-harvest management of banana leaf and research carried out on post-harvest management of banana leaf is summarized and presented under IN FOCUS of this Newsletter. Use of banana leaves as biodegradable dining plates has both cultural and ecological significance. Banana leaf industry has become a source of livelihood for several marginal and small farmers in South India. Banana leaf production/harvesting has become commercial venture for most of banana growers due to its continuous demand for leaves throughout the year and providing year-round sustained source of income for farming families and ability to balance the price-fluctuation faced by the farmers in fruit industry to a greater extent and potential to adopt to varying production systems. With the ban on use of plastics, leaf industry has viewed as a potential alternative for various uses and applications. Surveys were conducted in major banana growing tracts of Tamil Nadu and documented banana varieties cultivated for leaf purpose. Experiments were conducted on shelflife of banana leaf and temperature and other parameters were standardized for better storage. Similarly, number of suckers per hill was standardized for maximum production of banana leaf.



In Crop Improvement Section, notable research achievements during April – September, 2018 includes standardization of protocol for developing multiple shoots from a single embryo; development of *Fusarium* wilt resistant progenies; identification of *Fusarium* wilt resistant mutants and development of ornamental *Musa* hybrids. Identification of drought tolerant genotypes; encapsulation of anthocyanin pigments; Nutraceutical

analysis of banana cultivars; optimization of organic banana production system; value addition and standardization of banana flour based products are few research milestones in Crop Production and Post Harvest technology Section. In Crop Protection Section, salient research findings include first report of three new insect pests on banana; identification of biocontrol agent effective to root-knot nematode; standardization of Carbendazim application for *Fusarium* wilt disease management; identification of *Fusarium* wilt resistant / tolerant genotypes and standardization of simultaneous detection technique for Banana Bract Mosaic Virus and Cucumber Mosaic Virus using single dip-stick.

ICAR-NRCB participated in two exhibitions (Agri Summit & Expo, 2018 and Kisan Samruthi Mela, 2018) and displayed its technologies to farmers and the public. The centre conducted a brainstorming meet on banana fibre and value addition and conducted two trainings - one on-campus training to VFPC trainees from Kerala and one off-campus training to Pondicherry farmers. The centre celebrated its foundation day and kisan mela on 31 August, 2018. Shri Chhabilendra Roul, IAS, Special Secretary DARE and Secretary, ICAR, New Delhi was the chief guest of the function. Parthenium awareness week was also observed during 16 – 22 August, 2018. ICAR-NRCB with its strong network with KVK's, SAU's, farmer's federations etc. is involved in many outreach programs to increase livelihoods of the farmer.

IN FOCUS

PRE AND POST-HARVEST MANAGEMENT OF BANANA LEAF

Banana is popularly known as 'Kalpatharu' (a plant of all virtues), since all parts of the plant can be utilized for various purposes. India is the largest producer of banana, producing 29

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million tonnes from an area of 8.50 lakh hectares (2016-17). Banana is grown almost in all the states of the country with a productivity of 37 metric tonnes per ha. India contributes to 16.41% of the global banana production. In order to reduce the post-harvest losses and to enhance the shelf life in bananas and plantains, it is essential to adopt scientific technologies during harvesting, post-harvest handling, pre-treatments, packing, storage and ripening techniques for domestic and export markets.

It is a traditional practice in South India to serve food in banana leaf. Banana leaves are predominantly used by Hindus and Buddhists as a decorative element for marriages and other auspicious ceremonies in India and Southeast Asian countries. The Indians also believe that banana leaf gives special taste to the food served on it. Banana leaf production has gained business status in Tamil Nadu, Karnataka, Kerala and Andhra Pradesh. Currently, the annual turnover is estimated to be Rs. 250 million which is approximately equivalent to 1/7th of the annual turnover of banana industry. Use of banana leaves as biodegradable dining plates has both cultural and ecological significance. Banana leaf industry has become a source of livelihood for several marginal and small farming communities. Banana leaf production/harvesting has become a commercial venture for most of banana growers due to the continuous demand for leaves throughout the year. It provides year-round sustained source of income for farming families and the ability to balance the price fluctuation faced by the banana farmers to a greater extent. There are no commercial varieties/cultivars available exclusively for leaf production. Till today, commercial varieties/cultivars for fruit purpose such as Poovan, Monthan, Peyan, Sakkai and Karpooravalli are exploited for leaf purpose. In recent times, the banana leaves are exported in bulk and the demand is on rise. Hence, there is a need to evolve cultivars specific for leaf industry to meet the growing demand in the domestic as well as international markets and to develop techniques to preserve the green leaves and for drying.



Banana leaf plate



Paglapahad wild

Survey for varieties suitable for leaf purpose

Surveys were conducted in the major banana growing tracts of Tamil Nadu in order to document and understand the major varieties cultivated for leaf purpose and practices adopted for production, harvesting and post-harvest handling to produce

District in Tamil Nadu	Preferred cultivar for leaf production
Coimbatore & Tiruppur	Poovan & Karpooravalli
Cuddalore	Monthan & Poovan
Madurai	Nattu Monthan / Naadu
Thanjavur	Poovan
Theni	Ney poovan, Grand Naine, Red Banana & Nattu Monthan
Tiruchirappalli	Karpooravalli & Poovan
Tirunelveli & Toothukudi	Nattu Monthan & Poovan

quality leaf and to extend the shelf life of the leaves. Among wild varieties, Paglapahad wild was found to be best.

Survey on leaf production

A plant population of 1000 to 1200 plants/acre is maintained for leaf purpose. Fertilizer is applied on 3rd, 5th and 7th month after planting. Whenever there is water shortage in canal irrigation, the farmers go for leaf production, instead of growing for bunches. Harvesting is done after six months regularly at weekly interval on the same plant at about 1000 leaves per day. Leaves are harvested at half or 3/4th unfurled stage. Leaves are graded in to two sizes (1'9" x 1'6" & 1' x 1'6") based on the purpose of use. Demand for banana leaves is at its peak during January-February and is low during July-August. A net Profit of Rs. 75,000/- to 1,00,00/- per acre can be realized.

Comparative evaluation of shelflife of leaves

Shelf-life of banana leaves of ten commercial varieties (Poovan, Karpooravalli, Udhayam, Rasthali, Saba, Monthan, Pachanadan, Nendran, Mortaman & Ney Poovan) and five wild species (Progeny 183, Phagalapad wild, Kungsa wild, Elavazhai & Phirima wild) were evaluated at room temperature and it ranged from 3-6 days.

Standardization of pre-treatments and storage of leaves

Cold water treatment of Poovan and Udhayam leaves at 20°C for 30 minutes extends the shelflife to eight days against three days at room temperature without any pre-treatment. Treatment at 25°C for 30 minutes registered a shelflife of seven days when compared to five days at room temperature alone. Leaves kept immersed in water for 1hour daily had extended shelflife more than untreated one kept in room temperature (control). In this method leaves of Kungsa wild got extended by ten days and leaves of Karpooravalli, Saba, Progeny 183, Phagalapad wild, Ezha Vazhai and Pirima wild got extended by five days.

Storage temperatures on shelf-life of leaves

At 10°C, leaves of commercial varieties retained freshness for up to 30 days, but the leaves became deformed. The shelf-life of leaves in commercial varieties of banana was extended up to 14 days at 15°C, 8 days at 20°C and 6 days at 25°C. However, the shelflife of leaves in wild species last up to 16 days at 15°C, 10 days at 20°C and 9 days at 25°C.

Packing of banana leaves

Use of foam sheet for packing the leaves of cv. Poovan extended the shelflife of leaves for 14 days at 13.5°C cold storage, followed by packing with wet gunny bags for 13 days, compared to storage at room temperature (9 days). However, single layer leaves registered the least shelflife.

Variations in physiological parameters of fresh leaves

Observations on chlorophyll and lignin content of fresh leaves in different varieties of banana showed significant differences. Cv. Udhayam recorded the highest chlorophyll and lignin content of fresh leaves, followed by Saba. Poovan, Pachanadan and Rasthali had moderate chlorophyll and lignin contents. Significant differences were noticed among the varieties for chlorophyll content during the course of shelflife. The varieties Elavazhai, Phirima wild and Progeny No. 183 registered higher chlorophyll content in initial stage. However, Udhayam, Poovan and Karpooravalli had moderate chlorophyll content in the beginning and by the end of shelflife.

No. of suckers /hill	Harvestable leaves/month	No. of leaves produced	Total leaf area production (m ²)/month
3	20.1	13-33	7.9-18.4
4	17.0	12-19	5.0-13.6
5	13.2	10-15	3.9-12.2

Effect of number of suckers on leaf production

A trial was laid out in Cv. Poovan to study the effect of number of suckers on leaf production by following farmers' practices. The first crop was raised for fruits and the bunches were harvested. The first ratoon/second crop was allowed for leaf purpose. Three suckers per hill produced the maximum number of harvestable leaves, followed by four and five suckers per hill.

RESEARCH HIGHLIGHTS

Crop Improvement

- ◆ Finetuning of protocol for developing multiple shoots from a single embryo has been completed for more than 20 cross combinations.
- ◆ Two progenies of Calcutta 4 x Kadali (IIHR) were found to be *Fusarium* wilt (race 1) resistant.
- ◆ One primer (PC10G) designed from mitochondrial transporter showed clear polymorphism between the seeded (AA) and parthenocarpic accessions (AA and AAA) of A genome.
- ◆ Callus formation was observed in the endosperm of *Musa balbisiana*.
- ◆ Identified two *Fusarium* wilt (race 1) tolerant mutants of cv. Rasthali (NRCB - RM 217 and 100) and one resistant Grand Naine mutant.
- ◆ 153 accessions genotyped using seven SSR primers and 40 accessions phenotyped for *Fusarium* wilt towards association mapping.
- ◆ Developed regression equation for genome prediction in banana using stomatal traits and chloroplast using 240 germplasm accessions.
- ◆ Developed 40 open pollinated *Musa velutina* hybrids and seeds of *M. ornata* x *M. laterita* (320), *M. laterita* x *M. ornata* (110) and *M. ornata* x *M. ornata* (800) were extracted and subjected to embryo culture/direct sowing.



Bunch of Grand Naine mutant resistant to *Fusarium* wilt race 1

Crop Production and Post Harvest Technology

- ◆ Banana genotypes 'Sakkai', 'Ney Vannan', 'Nepali China' and 'Vennutu mannan' were identified as drought tolerant at flowering stage.
- ◆ Anthocyanin pigments extracted from Nendran flower bracts were made into powder, mixed with wall materials, spray dried and encapsulated.
- ◆ Estimation of crude oil contents in peel of banana cultivars

viz., Poovan, Red Banana and Grand Naine showed that Red Banana contained the highest oil content.

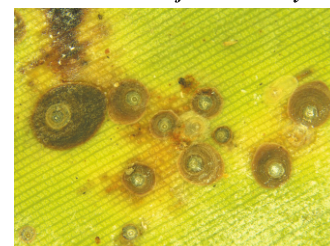
- ◆ Extraction and analysis of flavonoid contents in ripe fruit peels of seven banana cultivars showed cv. Monthan contained the highest amount of flavonoids followed by Udhayam, Rasthali and Grand Naine.
- ◆ Among the varieties tested for antioxidant activity of peel flavonoids, Poovan showed maximum 94% activity.
- ◆ In organic banana cultivation, treatment combination of poultry manure, groundnut cake, rural compost and wood ash recorded the highest bunch weight, pulp/peel ratio, total soluble solids (TSS), TSS/acidity ratio, optimum soil colony forming units (CFUs) of actinomycetes, fungi and bacteria was on a par with that of inorganic fertiliser alone.
- ◆ Among the various agents used for induced/commercial ripening of banana, ethylene gas proved to be the best with acceptable quality parameters in cv. Udhayam.
- ◆ Among the various combinations of banana flour used for making snacks, banana flour and rice flour @ 20:80 gave better results with acceptable level.
- ◆ Cultivar Monthan (24.89%) has high amylose content followed by cvs. Saba (23.67%), Nendran (21.18%) and Grand Naine (16.83%). The starch content of banana flour varies from 69.29 to 81.33%.
- ◆ Minimal processing of cut banana slices was standardized for short term storage for up to 14 days under refrigerated condition under pre-treatment of the slices with Potassium meta bisulphite (0.5%) storing in metalized polypropylene.

Crop Protection

- ◆ Three new insect pests *viz.*, *Asprothrips navsariensis*, *Pseudococcus jackbeardsleyi* and *Lindingaspis misrae* were recorded on banana for the first time of which *P. jackbeardsleyi* is an alien invasive pest.
- ◆ Evaluation of *Fusarium* wilt suppressive native isolates of biocontrol agents *viz.*, *Trichoderma asperellum*, *Penicillium pinophilum*, *Trichoderma* sp. and *Bacillus flexus* against root-knot nematode, *Meloidogyne incognita* on cv. Grand Naine showed that *T. asperellum* was better in reducing nematode population and improving plant growth.
- ◆ Soil drenching with carbendazim @5g/Liter of water for three times at 15 days interval recorded 50% reduction of wilt disease in cv. Grand Naine.
- ◆ Out of 40 accessions evaluated against *Fusarium* wilt pathogen (race 1 - VCG0124) under pot culture conditions, Dwarf Cavendish, K. kunnan, Njali poovan, Ladies finger, Hoobale, Jahaji, Williams, Borjahaji, Nanjungud Rasabale (618) and Attrusingan (497) were found tolerant.



Pseudococcus jackbeardsleyi



Lindingaspis misrae

- ◆ The second ratoon crop of embryogenic cell suspension (ECS) derived banana bunchy top virus (BBTV) free Hill banana showed significant increase in the growth and yield parameters compared to sucker derived plants.
- ◆ Evaluation of tissue culture plants of banana streak mysore virus (BSMYV) free Poovan showed significant difference in growth and yield parameters compared to suckers derived Poovan.
- ◆ A protocol was standardized for simultaneous detection of banana bract mosaic virus (BBrMV) and cucumber mosaic virus (CMV) using single dip-stick.
- ◆ Among 36 isolates of beneficial microbes isolated and tested for plant growth promotion, three isolates recorded significantly high plant growth promotion. Among three isolates of *Beauveria bassiana* tested, the isolate IBC1 caused 100% infection of grubs of banana pseudostem weevil, *Odoiporus longicollis*.

OTHER INFORMATION

Brainstorming meet on Banana fibre

ICAR-NRCB organized a one-day brainstorming meet on "Banana fibre: Research needs for commercial exploitation" on 10 May, 2018. Representatives from ICAR institutes viz., ICAR-CIRCOT, Mumbai; ICAR-CIAE(RS), Coimbatore; central institutes including NIT, Tiruchirappalli; SITRA, Coimbatore; MSME, Govt. of Tamil Nadu and SAUs viz., TNAU, Coimbatore and NAU, Gujarat participated and deliberated. The meeting



The Director, ICAR-NRCB interacts with participants of 'Brainstorming meet on banana fibre'

discussed identification of researchable issues and development of project proposals for utilization of banana fibre. An exhibition was also arranged during the event with the displays of handicrafts and fabrics made from banana fibre.

ICAR – NRCB celebrates silver jubilee foundation day & Kisan Mela

ICAR-NRCB celebrated its silver jubilee foundation day and kisan mela on 31 August, 2018. Shri Chhabilendra Roul, IAS,



Secretary, ICAR and Director, ICAR-NRCB along with awardees at ICAR-NRCB Foundation day and Kisan Mela

Special Secretary (DARE) and Secretary, ICAR, New Delhi was the chief guest of the function. He inaugurated three new research facilities at ICAR-NRCB and distributed awards to best banana growers and entrepreneurs. He also chaired the "Banana stakeholders meet" attended by more than 40 stakeholders representing banana exports, processors, FPO's, engineers involved in developing instruments for banana value chain, other ICAR institutes, SAU's, State department functionaries, academicians, scientists and leading banana growers from various parts of the country. Drs. K. N. Shiva and V. Kumar, Principal Scientists, delivered lectures on 'pre- and post-harvest handlings, value addition, shelf life enhancement and package of practices for export bananas'.

Agri Summit & Expo 2018

ICAR- NRCB participated and exhibited more than 100 varieties of banana in Agri Summit & Expo 2018 held at Tiruchirappalli, Tamil Nadu during 8-10 June, 2018. More than 15,000 visitors including farmers, students, entrepreneurs and general public visited ICAR-NRCB stall.



District Collector, Tiruchirappalli visited ICAR-NRCB stall at Agri Summit & Expo 2018

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