



Strategic Plan (2012 – 2017)

for

ICAR-National Research Centre for Banana

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Introduction

The ICAR-National Research Centre for Banana (ICAR-NRCB) was established on 21st August 1993 to conduct basic and strategic research for enhancing the production, productivity and profitability of banana in the country.

Among the horticulture crops, banana is the important fruit crop grown in an area of 0.80 million hectares with the production of about 29.3 million tons annually. The productivity has also witnessed 3 fold increases due to the adoption of improved technologies developed. Still there is great scope for improving the productivity as observed in many banana growing states like Maharashtra, Tamil Nadu, Gujarat and Andhra Pradesh which can be replicated in other banana growing states which have recorded lower productivity. There is great potential in export of banana, though India is the largest producer, export continues to be negligible. Since banana is grown by small and marginal farmers, it has great influence on the livelihood and nutritional security of the millions of farmers and consumers. To face these challenges, we need to convert these weaknesses into opportunities through technological advances and adoption by the farmers which provides livelihood, nutrition and profitability to the farmers and consumers. This strategic formulation also involve enhancement of capacity for growth, up gradation of skills, market access and human resource development for sustainable growth.

Section 1: Vision, Mission, Objectives and Functions

Vision To increase the production and productivity of quality bananas through technological interventions

Mission To become the global leader in banana production and productivity and export of banana

Objectives

1. Enhancing the productivity and quality of bananas and plantains
2. Post harvest technologies/value addition and technology dissemination

Functions

1. Developing improved production and protection technologies to enhance the productivity in banana
2. Planning, coordination, implementation and monitoring of Banana R&D programmes for sustainable and profitable inclusive banana production.

These functions are being performed under the following priority areas

Research

The research work is conducted by the Centre under different in house and externally funded multidisciplinary research programmes. The research Centre has created the state-of-the-art laboratories for conducting various basic and strategic research in the field of biotechnology, genomics, genetics and plant breeding, crop production and crop protection, soil science, plant physiology, biochemistry and post harvest technology. The centre's laboratories such as Genetic Fidelity Testing Lab and the Virus Testing Lab have been notified by the DBT, Government of India as 'Accredited Test Laboratory' for testing and certification of tissue culture raised banana plants for genetic fidelity and virus indexing of banana tissue culture plants produced by tissue culture laboratories. In addition, the biotechnology laboratory of the Centre has world-class facilities for transgenic research, structural and functional genomics, cell biology and somatic cell genetics, molecular breeding etc., Besides, the Centre also has got well-equipped Fungal and Bacterial Pathology Laboratory as well as Transformation Laboratory with facility for basic and applied research. Besides, the institute also has laboratories for Soil Science, Plant Physiology and Post Harvest Technology works.

Training

The ICAR-NRCB is involved in imparting training regularly to the agriculture/horticulture officers of State Departments, Scientists of SAUs, and NGO's. Besides, the Institute also imparts training directly to the farmers on limited scale through frontline demonstration, *kisan melas*, field days, field visits and lectures.

Consultancies

The Centre also provides consultancy services on banana cultivation and micro propagation, testing of various inputs etc.,

Section 2: Assessment of the Situation

2 A. What external factors will impact us?

a. Political

1. Commitment of the government to fund R&D in horticulture sector.

2. International cooperation and coordination especially with developing countries for exchange of plant material.
3. Specific guidelines for encouraging research on GM crops.
4. Center-state relations with respect to agriculture/horticulture policies.
5. Lack of policy support for PPP mode in R and D in horticulture.

b. Economical

1. Budget allocation and timely release of funds.
2. Lengthy procedures for timely procurement of resources for research.

c. Socio-cultural

1. Small farm holding, a limitation for mechanized farming.
2. Changing consumer preferences from time and again.
3. Decrease in arable land due to rapid urbanization.

d. Technological

- Development of varieties with resistance to multiple diseases, post harvest, drought and salinity is needed. In banana, development of a new variety is a problem due to its varied ploidy level. There is a need to use the biotechnological tools in conjunction with the conventional breeding strategies to identify the genes for specific characters using Marker Assisted selection and also development of transgenic plants with desirable traits.
- Region specific technologies for maximizing the productivity by utilization of available natural resources like soil, water, nutrients and other edaphic factors.
- Banana being water loving plant, development of technologies for increasing the water use productivity and nutrient use efficiency. Also, there is a need to develop precision farming techniques for improving the productivity using IT based technologies.
- In order to get higher productivity and maximize the returns, usage of locally available eco-friendly inputs, organic farming technologies to be standardized.
- Identification and development of eco-friendly technology for effective management of biotic stresses like nematodes, insect pests and diseases.
- Development of innovative technologies for rapid, accurate and cost-effective detection of important fungal and viral diseases.

- To minimize the post harvest losses, development of improved production and post harvest technologies for improving the product quality coupled with value addition for enhancing the profitability.
- Development of inter-institutional mechanism and dissemination of technologies for better adoption by the farmers.

e. Environmental

1. Biotic stress and abiotic stress like moisture, heat and salinity stress.
2. Soil fatigue: Excessive/inadequate use of fertilizers resulting in nutrient imbalance.
3. Mitigation strategies to reduce methane and CO₂.

f. Legal

1. Sanitary and phyto-sanitary standards and the bio-safety regulations for use of beneficial microorganisms as bio-fertilizers and bio-pesticides.
2. IPR issues related to plant varieties, the rights of farmers and plant breeders.

2 B. Who are our stakeholders?

1. Farmers, entrepreneurs, SAUs, State Departments of Horticulture/Agriculture, private Industries and input suppliers, NGOs, marketers, exporters, and policy makers.
2. Sister organizations like BARC, DBT, DST, CSIR, NHB, BCIL and PPV&FRA, NSC, APEDA, Ministry of Food processing Industries etc.,
3. Financial Institutions like Banks, crop Insurance companies, NABARD, SIDBI *etc.*
4. International organizations like Bioversity International etc.,

2. C. What are our strengths and weaknesses?

Strengths

- The North East region is the home of many wild bananas and wild relatives which are potential gene donors for many biotic and abiotic stresses.
- India has the largest diversity especially BB and ABB genome, which is the gene sources for resistance to biotic and abiotic sources which can be utilized in the breeding program for evolving hybrids.
- The centre has collected all the available land races, accessions wild and related species from all over the world and also from India, which are conserved in the field gene bank which could be further exploited in the breeding program.

- Due to the availability of different varieties of banana and plantain throughout the year and intensive cultivation practices with higher productivity and availability in different regions could be strengthened for the export of bananas.

Weaknesses

- Average productivity is low as compared to some states with maximum productivity of 60-70 tons / hectare. This may be due to growing of low-yielding local cultivars and non-adoption of improved production and protection technologies.
- Biotic stresses like wilt and leaf spot diseases, weevils, nematodes and viruses are the major threats in reducing the productivity and also sustainability.
- The post harvest losses are estimated to be 20-30% which accounts for 200-300 crores monetary loss.

Opportunities

- India being a tropical and sub-tropical region, banana can be grown in any season and the fruits will be available throughout the year which provides an opportunity for export of banana to the foreign markets. Due to the varying production systems and regional peculiarities provides opportunities for the cultivation of bananas from coastal region to hill region which production constraints can be manipulated.
- After the WTO regime, there is an enhanced opportunities for export of banana due to cheap production cost and availability of organic bananas.
- Due to the availability of tissue culture plants in large quantity which is free from pests and diseases and viruses, the productivity of these plants are very high thereby the farmers are getting very high profits.

Threats

- There is a great threat to the wild Musa species and other related species due to the deforestation, Jhum cultivation and urbanization in the Centers of diversity and hence, a national repository has to be identified for conservation of these valuable germplasm and has to be characterized for finger printing these materials under the IPR regime.

- Due to the indiscriminate use of infected planting materials there is a threat to spread the diseases in the non-traditional areas also. Spread of new virus diseases, insect pests, nematodes and diseases like *Erwinia* are becoming serious threats in banana cultivation.
- Import of new varieties by the tissue culture companies without proper quarantine measures at the entry point may lead to introduction of new diseases, races and viruses to India which may threaten the cultivation of bananas and banana industry.

2. D. What do we need to learn?

There is a need to update the technologies to meet any emergencies faced by the farmers due to many challenges crept in the production system. Of late, there is a need to develop effective management strategies to meet the emerging scenario of leaf spot diseases in Maharashtra region. This needs capacity building programme in new areas like GIS application, Crop modelling and other related studies. Thus creation of new knowledge is needed to tackle the emerging constraints in the production system.

Section 3: Outline of the Strategy

The research priorities should be focused to achieve higher production and productivity with minimum cost of cultivation. With escalation in the input cost like water, fertilizers and quality planting material coupled with plant protection measures for the control of major pests and diseases are the major limiting factors in improving the production of bananas. To overcome this hurdles, the priority should be given to high yielding bananas with resistant to major biotic stresses. To achieve this, collection of genetic diversity and identification of resistant gene sources using advanced biotechnological tools should be given importance. Technology for increasing the efficiency for water and nutrient use with better cropping system has to be evolved. To improve the soil health and substrate dynamics, suitable technologies involving integrated nutrient management and organic farming has to be given priorities. Integrated management of insect pests, nematode and diseases involving bio-control methods, botanicals, PGPR has to be given priority to safeguard our ecosystem without polluting the environment. To overcome these hurdles, greater importance has to be given in evolving plants resistant to major biotic and abiotic stresses using molecular breeding and genetic engineering techniques incorporating resistant genes from wild *Musa* gene sources.

In this regard, highest priority should be given for conservation of the available genetic wild material from the Centers of diversity using molecular tools needs utmost attention in the era of IPR regimes.

Keeping the above perspective in mind, the following strategies are proposed:

- Genetic resource enhancement, its evaluation and valuation for effective use to meet the challenge of biotic and abiotic stresses, besides yield, quality and nutritional value.
- Developing efficient system for management of nutrient and water to get optimum production from unit of water and nutrient used and to develop the management system to address the problem of biotic stresses to reduce the production losses
- Develop diagnostic for early detection of diseases utilizing molecular technology
- Develop forecasting model for early warning against leaf spot diseases and pests and utilize bio-intensive system for effective management of plant health.
- Develop a system for post harvest management for quality fruits with reduced losses and also development of surplus into value added products.

What are the priorities?

It is important to prioritize the various strategies and all the strategies should be linked to achieve the goal of increased productivity and profitability. Genetic resources are needed to develop new cultivars with multiple resistances to biotic stresses, need new science of biotechnology, bioinformatics, bio-sensing and expression of genes. Diagnostic is also essential for disease free planting material production so is the technology for post harvest management. Therefore, research prioritization would be given in order to achieve the goal of increasing the production and productivity of banana.

Strategies initiative 1: Identification of new genes and its utilization for development of cultivars / hybrids with utilizing new tools and technique.

Strategies initiative 2: Production system management with high density planting for enhancing productivity of banana with minimal use of water, nutrients and other inputs.

Strategies initiative 3: Plant Health management utilizing diagnosing, and bio-intensive management of pests, nematodes and diseases.

Strategies initiative 4: Post harvest management and value addition through processing and waste utilization. This is a most important area of research to reduce the losses and add value to produce for enhanced marketability.

Strategies initiative 5: Human resource development of par excellence for taking knowledge further and capacity building of stakeholder.

S. No.	Strategy	Prioritization of Programme			
		Low	Medium	High	Rating %
1.	Identification of new genes and it utilization for development of cultivars / hybrids			√	20
2.	Production system management for enhancing productivity of banana involving efficient water, nutrient, plant population, micro-nutrients and farming systems.			√	30
3.	Plant Health management utilizing diagnosing, and bio-intensive management of pests, nematodes and diseases.			√	25
4.	Post harvest management and value addition through processing and waste utilization			√	20
6.	Human resource development		√	√	05
Total					100

Section 4: Implementation Plan

The basic and applied research for developing strategies to enhance productivity and utilization of bananas and plantain would be carried out primarily by the scientists of the Centre through various research programs and projects in both in-house, and various other externally aided projects. Inter-institutional and International collaboration would be taken up wherever felt essential for enhancing skills and sharing of knowledge and resources for quality research output. The Institute would also be addressing location-specific problems along with its ongoing research programs. Technology dissemination would be done by the scientists and more emphasis would be laid on commercialization of the technologies developed by the Centre through transfer of technologies, hands on trainings and also through licensing of the technologies for wider and accelerated spread of the technologies among the banana growers.

Resources required

Sufficient and need based budgetary provisions, timely release of funds and modern infrastructure are the major resources required. Revamping the organizational set up, reorientation of the research programs based on the gaps and thrust areas identified in the process of implementation of the strategic plan need to be taken up with appropriate fund allocation

through budgetary provisions. Sufficient trained human resources and skill up gradation is another pre requisite for the success of the strategic plan.

Considering the national need and global concern, the thrust areas has been formulated is as projected below:

1. Genetic Resource Management	Collection, evaluation and utilization of germplasm for direct utilization
2. Development of elite varieties resistant to biotic and abiotic stresses	Development of synthetic diploids and its use in breeding, development of biotic and abiotic resistant commercial varieties through mutation breeding etc.,
3. Production system management for enhancing productivity of banana	Development of technologies for organic farming, nutrient management through recycling, banana based cropping system, soil nutrient and dynamics studies including micro nutrients and precision farming technologies etc.,
4. Mitigation of high temperature and salinity due to climate change	Identification of genotypes and genes responsible for high temperature, salt and CO ₂ level
5. Plant Health management utilizing diagnosing, and bio-intensive management of pest, nematodes and diseases.	Molecular approaches in host plant defense against insect pests, developing IPM technologies for the management of banana inspect pests and nematodes, to determine the distribution of plant parasitic nematodes and their pathogenic variability. Genetic diversity and development of molecular markers for the early diagnosis of important pathogens of banana Development of effective consortium of bio-agents for the management of banana diseases Development of new diagnostic techniques and kits for major banana viruses and virus resistant transgenic plants, climate change and its impact on the epidemiology of virus diseases and developing a model for forecasting the disease incidence.
6. Post harvest management and value addition through processing	Development of improved post harvest handling and storage techniques, refinement and popularization of value added products and ripening mechanism in banana

Section 5: Linkages between strategic plan RFD

The strategic plan is long duration with broader thrust areas to be carried out during the period envisaged while, the results-framework document (RFD) is an action plan oriented document which plan the activities based on the strategic plan with deliverables.

RFD 2014-2015 of ICAR-NRC for Banana

Section-2: inter se priorities among Key Objectives, Success Indicators and Targets

S. No.	Objectives	Weight	Action	Success Indicators	Unit	Weight	Target/Criteria Value				
							Excellent 100%	Very Good 90%	Good 80%	Fair 70%	Poor 60%
1	Enhancing productivity and quality of bananas and plantains	50	Sustainable use of genetic resources and improvement of banana	Germplasm collected/characterized/evaluated/utilized and improved progenies/clones/markers/products developed	No.	20	28	23	18	13	8
			Development of improved production technologies	Improved production technologies developed	No.	15	4	3	2	1	0
			Development of improved protection technologies	IPM components/technologies/processes/diagnostics/concepts developed	No.	15	6	5	4	3	2
2	Post harvest technologies/ value addition and technology dissemination	30	Development post harvest technologies/value added products	Post harvest technologies/value added products developed/refined	No.	6	5	4	3	2	1
			Providing services/quality certification	Tissue culture plants certified	No. (million)	8	12	10	8	6	4
				Micro nutrient mixture supplied	Kg.	4	4000	3000	2000	1000	0
				Quality planting materials produced/supplied	No.	4	8000	6000	4000	2000	0
			Dissemination of technologies through trainings/demonstrations	Trainings/demonstrations/other extension activities/consultancy services provided	No.	8	10	8	6	4	2
Publication/ Documentation	5	Publication of the research articles in the journals having the NAAS rating of 6.0 and above	Research articles published	No.	3	12	10	8	6	4	
		Timely publication of the Institute Annual Report (2013-2014)	Annual Report published	Date	2	30.06.14	02.07.2014	04.07.2014	07.07.2014	09.07.2014	
Fiscal resource management	2	Utilization of released plan fund	Plan fund utilized	%	2	98	96	94	92	90	
Efficient functioning of the RFD system	3	Timely submission of draft RFD for 2014-2015 for approval	On-time submission	Date	2.0	15/05/14	16/05/2014	19/05/2014	20/05/2014	21/05/2014	

			Timely submission of results for RFD 2013-2014	On-time submission	Date	1.0	01/05/14	02/05/2014	05/05/2014	06/05/2014	07/05/2014
Enhanced Transparency/ Improved Service delivery of Ministry/ Department	3	Rating from Independent Audit of implementation of Citizens'/Clients' Charter (CCC)	Degree of implementation of commitments in CCC	%	2	100	95	90	85	80	
		Independent Audit of implementation of Grievance Redress Management (GRM) system	Degree of success in implementing GRM	%	1	100	95	90	85	80	
Administrative Reforms	7	Update organizational strategy to align with revised priorities	Date	Date	2	Nov. 1 2014	Nov. 2 2014	Nov. 3 2014	Nov. 4 2014	Nov. 5 2014	
		Implementation of agreed milestones of approved Mitigating Strategies for Reduction of potential risk of corruption (MSC)	% of implementation	%	1	100	90	80	70	60	
		Implementation of agreed milestones for ISO 9001	% of implementation	%	2	100	95	90	85	80	
		Implementation of milestones of approved Innovation Action Plans (IAPs)	% of implementation	%	2	100	90	80	70	60	

Section 6: Cross departmental and cross functional issues

The cross functional and departmental linkages have been identified for effective implementation of the strategic plan with the following institutions.

The ICAR- NRC for Banana, Tiruchirappalli has cross-functional linkages and issues with the State Governments - the Departments of Agriculture / Horticulture, State Agricultural/ Horticultural Universities, Departments, like DBT, DST, CSIR, IISc, BARC, CDRI etc., and with international institutions such as Bioversity International and CIRAD, France, QUT, Australia, IEB, Czech Republic etc., It also has cross-functional issues with authorities dealing with release and notification of varieties/hybrids, issues of IPR and commercialization, pesticide residue, plant quarantine, DUS testing as well as import and export of germplasm.

Section 7: Monitoring and Reviewing arrangements

The research work conducted by the institute is reviewed every five years by a high power Quinquennial Review Team (QRT). Besides, the annual progress of research projects is critically reviewed by external body like Research Advisory Committee (RAC) and internally by the Institute Research Council (IRC). Progress of research activities is also monitored by the Indian Council of Agricultural Research through (i) monthly cabinet report, (ii) quarterly report, and (iii) six monthly reports and HYPM.