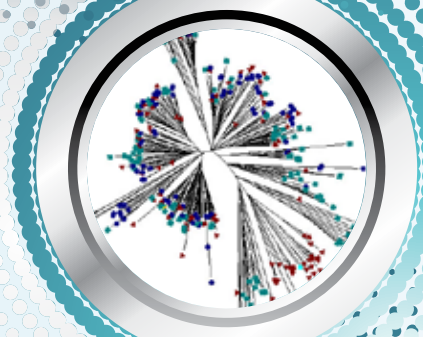

ANNUAL REPORT
वार्षिक प्रतिवेदन
2015-16

ICAR-Indian Institute of Agricultural Biotechnology

भाकृअनुप-भारतीय कृषि जैवप्रौद्योगिकी संस्थान

(Deemed to be University)

Garhkhatanga, Ranchi - 834 010 (Jharkhand)

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Preface

Agriculture with its allied sectors is the largest livelihood provider for more than 60% of Indian population. Indian agriculture is witnessing a phase of revolution due to advances in molecular biology and biotechnology. Concerted research efforts over the decades have made India self-sufficient in food grain production. However, the yield and productivity of grain legumes and oilseeds remain low and the demands are met by imports. Of late, it has been realized that the yield of most of the major crops has stagnated. In order to match the future projected demands for food in sustainable manner under the challenges due to global climate change, it is imperative to enhance yield potential of major crops and also reduce the losses due to biotic and abiotic stresses.

Recently, Hon'ble Union Minister for Agriculture and Farmers' welfare, Sh. Radha Mohan Singh ji during G-20 Agriculture Ministers' meet at Istanbul has rightly said **"enhancement in productivity and production can only be achieved through research"**. The unprecedented advancements in sequencing technologies need to be harnessed. It will enable researchers to dissect the complex traits and identify the key genomic regions underlying the crucial biological processes which in turn pave the way for their precise manipulation in desirable manner. In addition, the development of transgenic through genetic engineering approaches could also lead to breakthroughs to achieve food and nutritional security in India.

In the backdrop of advances made in frontier areas of biotechnology, advantages realized by the farmers using biotechnology driven technologies and huge potential in tackling anticipated problems with faster pace, ICAR has established ICAR- Indian Institute of Agricultural Biotechnology at Ranchi. It envisages to fulfill the future demand of biotechnology product, process, technologies and world class biotechnologists by undertaking research in frontier areas and post graduate teaching in all spheres of agricultural biotechnology. At present, the Institute is operating from a camp office established at the Process and Demonstration Unit (PDU) campus of ICAR-IINRG located at Namkum, Ranchi. Fifteen scientists of different disciplines have joined the Institute, so far. Even though, developmental activities are given priority at this stage but scientists of the institute have made efforts to organize research programmes under three major areas viz., Genomics and Bioinformatics, Translational Research for Crop Improvement, and Fish Health Management. The research programmes have been initiated with modest research facilities at ICAR-IIAB. This report embodies annual account of the work done by the scientists and various developmental works completed during the past one year.

It gives me immense pleasure to heartily congratulate all the scientific, administrative and finance staff of IIAB who contributed to this report. I express my sincere appreciation and complements to Dr. B.K. Singh, Dr. A.K. Singh, Dr. N.K.Sinha, Sh. Kishor U. Tribhuvan, Sh. Tanmoy Gon Choudhary and Sh. Anutosh Paria for their untiring efforts in preparing and bringing out this document.

With profound sense of pride and gratitude, I place on record my sincere thanks to Dr. T. Mohapatra, Secretary DARE, Government of India and Director General, ICAR; Dr. J.S. Sandhu Deputy Director General (Crop Science) and Dr. J.S. Chauhan, Assistant Director General (Seeds), ICAR for their unstinting guidance and support.

T. R. Sharma
Officer on Special Duty, IIAB, Ranchi
& Director, NRCPB, New Delhi

Ranchi
June, 2016

CONTENT

EXECUTIVE SUMMARY

Executive Summary

ICAR-Indian Institute of Agricultural Biotechnology (IIAB) is operating from its camp office cum laboratory building situated at Process and Demonstration Unit (PDU) campus, ICAR-IINRG, Namkum, Ranchi. The Institute is still at its infancy but has made a strong start. Although research infrastructure development had been the main focus of the Institute, the scientists at IIAB framed and initiated several new projects in the areas of crop improvement and fish health management. The salient achievements made by the Institute during 2015-16 have been summarized as follows:

- Considering the extraordinary tolerance of *Cicer microphyllum* to drought, a research project has been initiated with the aim to identify genes responsible for the trait. Seeds of *C. microphyllum* obtained from DIHAR, Leh were germinated on MS medium. The seedlings were transferred to the pots and subjected to drought stress. Total RNA was isolated and RNA-seq libraries were prepared for sequencing.
- Identification of genes/QTLs conferring terminal heat tolerance in lentil has been initiated using integrated genomics and genetic mapping approaches. Suitable heat tolerant and susceptible genotypes have been identified and are in the process of procurement.
- Marker assisted transfer of *Pup1* and combinations of *DTYs* for the development of drought tolerant and phosphorus efficient high yielding rice varieties has been initiated. Donor genotypes for *Pup1* have been short listed and process for acquiring their seeds has been initiated.
- Screening of rice genotypes for Zn efficiency has been initiated to identify genes/QTLs relevant to the trait.
- Screening of about 300 landraces collected from P limiting areas for P uptake and use efficiency has been initiated for identification of novel genes/QTLs responsible for the trait.
- Development of nanoparticle based recombinant protein oral vaccine for Indian major carps against *Aeromonas hydrophila* has been initiated.
- Identification of some important novel piscine homologues of antimicrobial peptides with wide magnitude of pathogen killing activity in striped catfish has been initiated.
- Two *Aeromonas hydrophila* phages were isolated from forty-six water samples collected from four sites of Mumbai. Host range of isolated phages were determined against various strains of bacteria pathogenic to fishes.
- Expression analysis of some immune-responsive genes post dietary supplementation of microbial levan in *Labeo rohita* fingerlings challenged with bacterial infection has been initiated.
- A total of 49 and 28 bacterial isolates were obtained from the nodules of *Flemingia macrophylla* and *F. semialata*, respectively. These isolates were biochemically characterized and screened in *in vitro* conditions for their plant growth promoting properties. The inoculation studies revealed that *Rhizobium* consortia increases the biomass of *F. macrophylla* up to 40% and thus can be used as efficient bio-fertilizer for the production of healthy and quick growing *Flemingia* seedlings at nursery stage.

- Among different plant growth regulators (PGRs) applications in *Flemingia semialata*, thiourea 1000 ppm and NAA 30 ppm were found to be effective in enhancing number of raceme/plant, floret number/raceme, seed set %, 1000 seed weight and seed yield.
- Based on criteria of Item Difficulty Index (ranging from 36.67 to 83.33) and Item Discrimination Index (ranging from 0.40 to 0.80), 20 statements were selected for knowledge test. A total of 18 statements (7 positive and 11 negative) whose 't' value ranged from 5.852 to 2.121 were selected, based on method of summated rating, for assessing attitude of people towards agricultural biotechnology. Knowledge test and attitude scale developed in the study would be used for assessing knowledge level and attitude of stake holders towards agricultural biotechnology.
- Inoculation of Zn solubilizing strain along with arbuscular mycorrhiza (AM) and 75 % recommended dose of fertilizers (RDF) with 25% N substituted by FYM was fond to be suitable for improving Zn content and yield in rice. Seed inoculation with *rhizobium* and PSB along with 75% RDF yielded at par with 100% RDF + inoculation in lentil grown under zero till condition in rice-lentil cropping sequence.
- Biosynthetic route of aleuritic acid in Indian lac insect was established by fatty acid profiling of two distinct life stages of lac insect viz. crawler (resin non-secreting) and adult (resin secreting).
- Small RNA of lac insect crawlers were sequenced using Illumina NextSeq platform. A total of 7609 and 6605 known miRNAs were identified for two replications. Besides, 16 novel miRNAs were also predicted from crawlers. The targets were predicted for all the identified miRNAs and they were found to fall into broad categories such as metabolism, genetic information processing, environmental information processing, cellular processes and organismal systems.
- Two molecular biology laboratories with modern research infrastructure are being established at ICAR-IIAB.
- Wet lab facilities for taking up experimental trials related to fisheries research have been established. A rainwater harvesting structure present in the Farm A of ICAR-IIAB has been renovated and converted into a fish pond.
- About 3.5 ha area has been developed for field experiments at Farm B of ICAR-IIAB. Deep well boring at six promising sites identified based on mapping of subsurface geological terrain is in progress.
- A 55 HP tractor and farm implements required for regular farm activities have been procured.
- A Library cum Committee room has been established.
- A logo depicting the essential domains of ICAR-IIAB has been designed.
- All categories of staff of ICAR-IIAB got opportunity to attend short-term trainings, conferences, meetings, seminars, symposia, workshops etc relevant to areas of their interest. Meetings of IRC, RAC, IMC and all other mandatory activities were organized.

ABOUT THE INSTITUTE

ICAR-IIAB

The foundation stone of ICAR-Indian Institute of Agricultural Biotechnology (IIAB) was laid by the Hon'ble Union Minister of Agriculture and Farmers' Welfare, Govt. of India on August 25, 2014 at Garhkhatanga, Ranchi (Jharkhand). Currently the institute is operating from a camp office established at the Process and Demonstration Unit (PDU) campus of ICAR-IINRG located at Namkum, Ranchi. IIAB envisages meeting the growing demand of agricultural products and processes with faster pace by deploying cutting edge molecular tools and techniques. Development of world class human resource by teaching and training at master, doctoral and post-doctoral levels in all the frontier areas of agricultural biotechnology is also the focus of the Institute. Educational curriculum developed by the Institute will be flexible, dynamic and modular to ensure demand-driven availability of biotech academia for teaching, research and allied organization/ industry. Molecular marker techniques will be used as an integral and supplementary part in all the breeding programmes. Trait-based genomic tools and resources will be developed by utilizing native landraces and wild species. Search for new genes, alleles and promoters from the vast biodiversity available in the country will be on the top priorities of the institute. The application of gene expression modulators to manipulate biochemical processes/pathways for desired developmental change, enhanced productivity and input use efficiency will be in common place of routine research. Development of designer agricultural crops with added beneficial components of the stakeholder's preference will be in place through biotechnological intervention. Considering the explosion in sequence information of various species, strengthening the big data management and analytical capability of the country with respect to infrastructure as well as human resource would be of one of the important research activities of the institute. Development of molecular diagnostics for precise identification of major diseases in plants, animals and fisheries and prophylactic measures for their control will also be taken up on priority level by the institute. Nanotechnology, being a naive and fast evolving scientific field, will be used for improvement in crop production through ultrasensitive detection system for disease and pest management, nano-delivery of pesticides, vaccines, nutrients/ hormones, genes etc. The institute will serve as a hub for biotech research activities undertaken under NARS by providing technical support and service facility for products, tools, protocols, techniques, database, sequencing, bioinformatics, safety studies and knowledge. Scientists at ICAR-IIAB have already initiated research in the areas of molecular breeding for guided integration of known QTLs for drought tolerance and phosphorus uptake in rice. Efforts for search of novel QTLs/genes and their characterization for phosphorus use efficiency, zinc homeostasis in native germplasm of rice, drought responsive genes from wild chickpea (*Cicer microphyllum*) and heat tolerance in lentil have been initiated under Institute research projects. Research on bacteriophage for fish disease control, nanoparticle based recombinant protein oral vaccine and characterization of genes responsible for immune response in fish has also been initiated. Research programmes are also being taken up earnestly to assess knowledge and attitude of people towards agricultural biotechnology and create public awareness about biotechnology driven deliverables and their impact and acceptability among the farmers.

Mandate

- Basic and strategic research in agricultural biotechnology
- Development of quality human resources for academic excellence in agricultural biotechnology and policy support

Staff Strength

Staff	Sanctioned	Filled	Vacant
Scientific	38	15	23
Technical	NIL	NIL	NIL
Administrative	02	02	NIL
Skilled Supportive Staff	NIL	NIL	NIL
Total Strength	40	17	23

Financial Statement

Budget allocation and utilization

(Rs. In Lakhs)

S No	Head	Plan			Non-Plan		
		B.E. 2015-16	R.E. 2015-16	Total Expenditure	B.E. 2015-16	R.E. 2015-16	Total Expenditure
1	2	3	4	5	6	7	8
Grants for Creation of Capital Assets (CAPITAL)							
1	**Works**	0.00	0.00	0.00	0.00	0.00	0.00
	A. Land	0.00	0.00	0.00	0.00	0.00	0.00
	B. Building	0.00	0.00	0.00	0.00	0.00	0.00
	i. Office building	1888.00	45.00	44.43	0.00	0.00	0.00
	ii. Residential building	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Minor works	0.00	0.00	0.00	0.00	0.00	0.00
2	**Equipment**	**3.00**	**28.00**	**25.84**	**0.00**	**0.00**	**0.00**
3	**Information Technology**	**5.00**	**3.00**	**1.55**	**0.00**	**0.00**	0.00
4	**Library Books and Journals**	**0.00**	**3.00**	**2.23**	**0.00**	**1.00**	0.00
5	**Vehicles & Vessels**	**0.00**	**12.00**	**0.00**	**0.00**	**0.00**	0.00
6	**Livestock**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.00
7	**Furniture & Fixtures**	**4.00**	**9.00**	**8.58**	**0.00**	**0.00**	0.00
8	**Others**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.00
	Total-CAPITAL (Grants for creation of Capital Assets)	**1900.00**	**100.00**	**82.63**	**0.00**	**1.00**	**0.00**

Grants in Aid - Salaries (REVENUE)							
1	**Establishment Expenses**	0.00	0.00	0.00	0.00	0.00	0.00
	A. Salaries	0.00	0.00	0.00	90.00	122.50	121.46
	i. Establishment charges	0.00	0.00	0.00	0.00	0.00	0.00
	ii. Wages	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Overtime allowances	0.00	0.00	0.00	0.00	0.00	0.00
	B. Loans and Advances	0.00	0.00	0.00	0.00	2.00	0.00
	Total-Establishment Expenses (Grants in Aid - Salaries)	**0.00**	**0.00**	**0.00**	**90.00**	**124.50**	**121.46**
Grants in Aid - General (REVENUE)							
1	**Pension & Other Retirement Benefits**	0.00	0.00	0.00	0.00	0.00	0.00
2	**Travelling Allowance**						
	A. Domestic TA/Transfer TA	6.00	13.00	12.95	0.00	1.50	0.35
	B. Foreign TA	0.00	0.00	0.00	0.00	0.00	0.00
	Total - Traveling Allowance	**6.00**	**13.00**	**12.95**	**0.00**	**1.50**	**0.35**
3	**Research & Operational Exp.**						
	A. Research Expenses	0.00	34.45	34.41	0.00	0.00	0.00
	B. Operational Expenses	25.00	9.00	9.00	0.00	0.00	0.00
	Total - Res. & Operational Exp.	**25.00**	**43.45**	**43.41**	**0.00**	**0.00**	**0.00**
4	**Administrative Expenses**						
	A. Infrastructure	18.00	23.20	23.12	0.00	0.00	0.00
	B. Communication	0.00	0.80	0.80	0.00	0.00	0.00
	C. Repair & Maintenance	0.00	0.00	0.00	0.00	0.00	0.00
	i. Equipment, Vehicle & Others	0.00	0.00	0.00	0.00	0.00	0.00
	ii. Office building	0.00	0.00	0.00	0.00	0.00	0.00
	iii. Residential building	0.00	0.00	0.00	0.00	0.00	0.00
	iv. Minor Works	0.00	3.75	3.71	0.00	0.00	0.00
	D. Other (excluding TA)	15.00	13.80	13.80	0.00	0.00	0.00
	Total - Administrative Expenses	**33.00**	**41.55**	**41.43**	**0.00**	**0.00**	**0.00**
5	**Miscellaneous Expenses**						
	A. HRD	1.00	1.00	0.93	0.00	0.00	0.00
	C. Other items (Fellowships, Scholarships etc.)	0.00	0.00	0.00	0.00	0.00	0.00
	D. Publicity & Exhibitions	0.00	0.00	0.00	0.00	0.00	0.00
	E. Guest House - Maintenance	0.00	0.00	0.00	0.00	0.00	0.00

	F. Other Miscellaneous	5.00	1.00	0.98	0.00	0.00	0.00
	Total - Miscellaneous Expenses	**6.00**	**2.00**	**1.91**	**0.00**	**0.00**	**0.00**
	Total Grants in Aid - General	**70.00**	**100.00**	**99.70**	**0.00**	**1.50**	**0.35**
	Total Revenue (Grants in Aid - Salaries + Grants in Aid - General)	**70.00**	**100.00**	**99.70**	**90.00**	**126.00**	**121.81**
	Grand Total (Capital + Revenue)	**1970.00**	**200.00**	**182.33**	**90.00**	**127.00**	**121.81**
*	**Tribal Sub-Plan Expenditure**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
*	**NEH Expenditure**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
*	**Non-Plan Scheme Expenditure with name**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Name of Plan Scheme/AICRP/Network Project etc.	B.E. 2015-16	R.E. 2015-16	Expenditure
1	**2**	**3**	**4**
National Agriculture Innovation Fund (NIAF)	6.00	6.00	1.83

Resource Generation

(Rs. In Lakhs)

Sales of Farm Produce	0.15
License Fee	NIL
Leave Salary and Pension Contribution	NIL
Interest Earned on Short Term Deposits	29.02
Income Generated from Internal Resource Generation	0.61
Miscellaneous Receipts	0.07
Total	**29.85**

RESEARCH ACHIEVEMENTS

Institutional Research Projects

GENOMICS AND BIOINFORMATICS

The advent of modern platforms for omics-based research provides crucial resources to promote research in crop plants. The integrated use of these platforms and their outcomes is now an effective means to understand the molecular systems which provide the basis for improvement in the productivity of crops. Comparative genomics on the other hand allows us to accelerate gene discovery and functional analyses of genes in crop plants taking advantage of the studies made in model species. Bioinformatics platforms and their associated databases are also essential for the effective design of approaches making the best use of genomic resources, including resource integration. Two research projects are currently being undertaken at the institute under the major program "Genomics and Bioinformatics".

Identification and characterization of drought-responsive genes in wild chickpea (*Cicer microphyllum*)

Cicer *microphyllum* is a wild relative of cultivated chickpea. It is naturally adapted to trans-Himalayan cold deserts and is distributed throughout the Leh and Ladakh areas of Jammu & Kashmir and Lahaul and Spiti areas of Himachal Pradesh. Considering the extraordinary tolerance of this species to cold and drought, research project has been undertaken with the aim to identify genes conferring tolerance to drought. The seeds of Cicer *microphyllum* were obtained from Defense Institute of High Altitude Research, Leh and germinated on Murashige and Skoog medium. The seedlings were transferred to pots containing vermiculite, 15 days after germination. Plants were allowed to acclimatize in pots for three days. Drought stress was imposed by withholding irrigation and the root and shoot tissues were collected after 5 and 8 days of drought stress. The control seedlings were watered as needed. Total RNA was isolated from the samples collected from control and drought stressed seedlings and RNA-Seq libraries were prepared using TruSeq RNA sample preparation kit. These libraries will be sequenced to identify drought stress responsive genes in C. *microphyllum*.

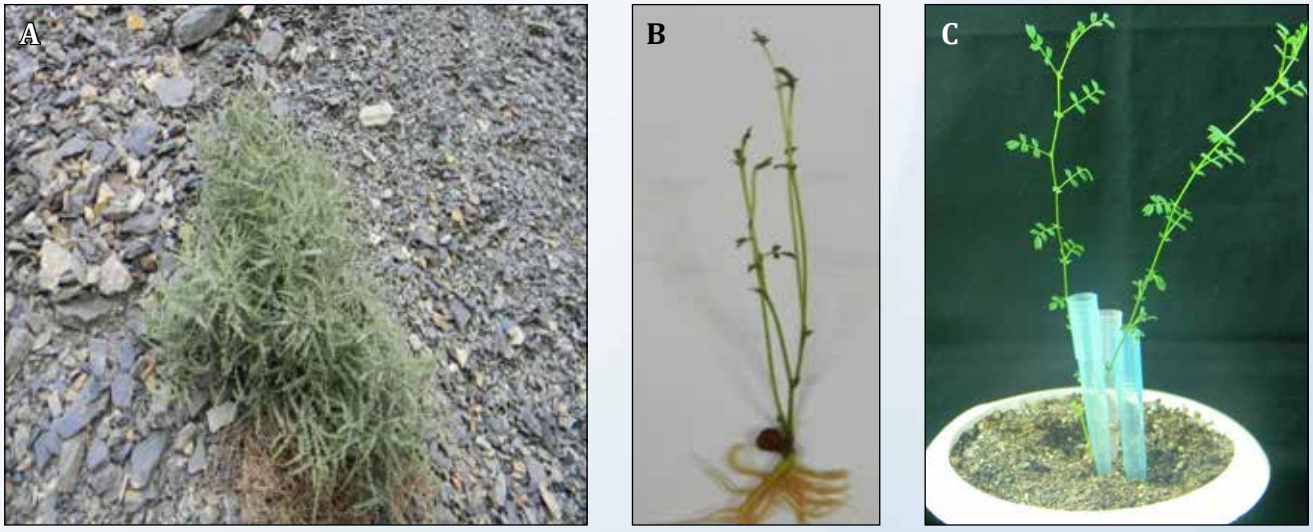

Fig 1: (A) *Cicer microphyllum* growing naturally in the cold desert of Lahaul and Spiti, (B) *In vitro* germinated seedling of *C. microphyllum*, and (C) *In vitro* germinated seedling grown in the pot containing vermiculite

Identification of genes/QTLs for heat tolerance in lentil

Lentil (*Lens culinaris*) is an important pulse crop grown and consumed in India. It is grown in the post-rainy season on residual moisture. Intermittent drought throughout the crop season and terminal drought and heat are common to this crop. This project envisages to integrate genomics and genetic mapping approaches to identify genes/QTLs conferring terminal heat tolerance in lentil. Based on thorough review of literature suitable heat tolerant and susceptible genotypes of lentil have been identified and are in the process of procurement.

TRANSLATIONAL RESEARCH FOR CROP IMPROVEMENT

Modern molecular tools offer unprecedented opportunities to rapidly identify functionally relevant genes/QTLs in crop plants. These genes/QTLs can now be easily introgressed into the crop plants through various genomics-assisted breeding approaches. In this endeavor, following three projects are being undertaken for the marker-assisted convergence of known QTLs for drought and phosphorus uptake, and identification of new genes/QTLs for phosphorus use efficiency and zinc homeostasis in rice.

Introgression of genes/QTLs for drought tolerance and efficient phosphorus uptake in rice using MAS

Varietal development for rainfed and low input areas did not receive adequate attention in the past and therefore the productivity in these areas continued to be low. Most of the crop varieties developed for irrigated and high input conditions often fail to perform in rainfed and low input areas. Of late, intensive efforts for identification of QTLs/genes for performance under drought and low nutrient conditions have been made and several QTLs for yield under drought (*DTY* $_{2.2}$, *DTY* $_{4.1}$, *DTY* $_{12.1}$ etc.) and efficient phosphorus uptake (*Pup 1*) have been fine mapped and successfully deployed using MAS and their utility demonstrated. This project envisages marker assisted transfer of *Pup1* and combinations of *DTYs* for the development of drought tolerant and phosphorus efficient high yielding rice varieties. Donor genotypes for *Pup1* have been short listed and process for acquiring their seeds has been initiated.

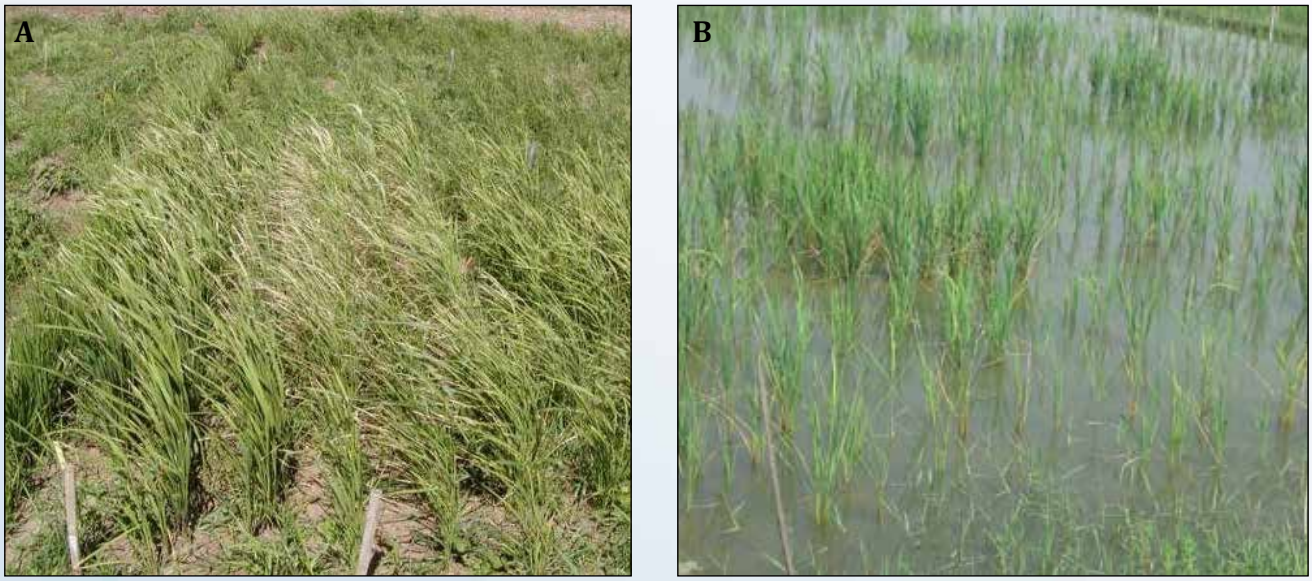

Fig 2: (A) Drought affected rice crop, and (B) Rice population segregating for *Pup 1*

Fig 3: Rice crop showing Zn deficiency

Identification and functional characterization of genes/QTLs responsible for Zinc homeostasis in rice

Zinc (Zn) deficiency in rice soils is a widespread problem throughout India particularly in low land areas. Significant genotypic differences in Zn efficiency is reported in rice. This project envisages screening of rice genotypes for Zn efficiency followed by identification and functional characterization of genes/QTLs relevant to the trait. Some of the Zn efficient rice genotypes have been identified and their seeds are being procured.

Identification and mapping of novel genes/QTLs for phosphorus uptake and use efficiency in rice

Phosphorus (P) is a vital nutrient required for growth and development of rice plant. Concerns are being raised that due to the limited P resources, unavailability of P fertilizers may become a serious problem in future. Thus, genetic improvement in rice for enhancing phosphorus uptake and use efficiency is an important rice research agenda.

The possibility of selecting and breeding P efficient rice varieties has been stimulated by increased knowledge about P-uptake differences in crop plants and their cultivars. In this project, a panel of rice genotypes of diverse plant type and origin will be screened under low-P conditions. About 300 landraces collected from

Fig 4: Rice accessions showing differential response under P deficient condition

P limiting areas have been short listed and their seeds are being arranged. These genotypes will be screened for P uptake and use efficiency and suitable genotypes will be used for identification of novel genes/QTLs responsible for the trait.

BIOTECHNOLOGICAL INTERVENTIONS FOR FISH HEALTH MANAGEMENT

Aquaculture is the fastest growing food-producing sector accounting for almost 50 percent of the world's fish production. The global aquaculture production reached 62.7 million tons in 2011 and is expected to reach 79 million tons by 2021. Due to increased demand, the culture systems are getting intensified which is leading to incidence of several diseases caused by bacteria, virus, fungi and parasites. Thus a major research program pertaining to fish health management through biotechnological interventions has been initiated at the institute with following four sub-projects:

Fig 5: The three Indian major carps: (A) Rohu, (B) Catla, and (C) Mrigal

Development of nanoparticle based recombinant protein oral vaccine for Indian major carps against *Aeromonas hydrophila*

Vaccination is the best health management practice in aquaculture and it has helped to control several fish diseases till date. Orally deliverable vaccines are best suited for mass vaccination and there is a huge research gap in developing orally deliverable vaccines to fish. This study aims to develop and evaluate a nanovaccine which can be delivered orally.

A biodegradable nanoparticle based, efficient oral vaccine against *Aeromonas hydrophila* can be expected from this research project. The data thus obtained can be used to solve the *A. hydrophila* infested disease problems in aquaculture. The data obtained will further help scientific community to standardise vaccine candidate against other pathogens.

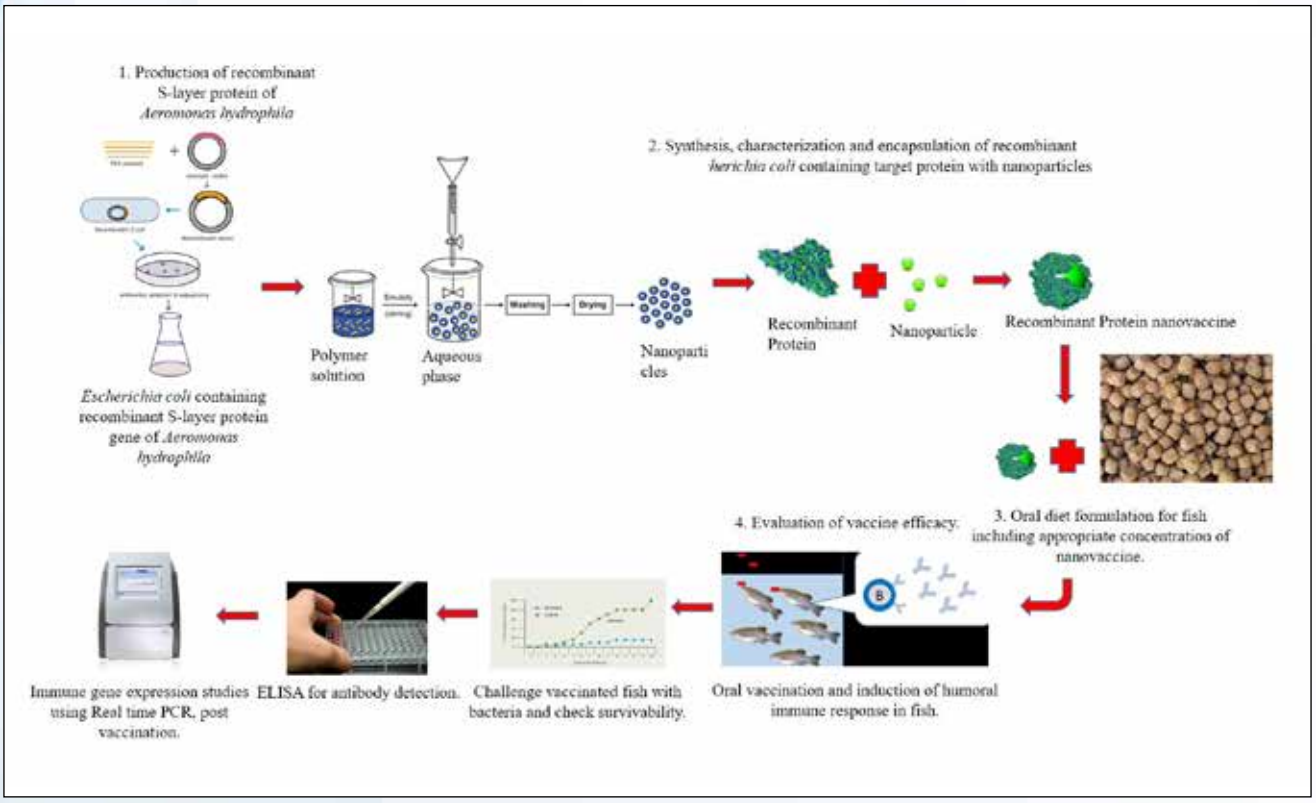

Fig 6: Flow diagram explaining the details of the project

Molecular characterization and functional analysis of antimicrobial peptides in response to pathogenic bacteria in striped catfish *Pangasianodon hypophthalmus*

Antimicrobial peptides (AMPs) are one of the pivotal humoral components of innate immunity. They serve as a critical first line of defense against many pathogens. Because of the wide activity against different microbial agents these molecules have made their mark as an emerging class of natural antibiotics. At the moment, the increasing incidence of antibiotic-resistant bacterial infections is of great importance in medicine, and AMPs could help to cope up this challenge. This project aims to identify some important novel piscine homologue of antimicrobial peptides with wide magnitude of pathogen killing activity in striped catfish. Broad spectrum AMPs can be used as adjuvant in vaccination process against wide array of microbes. Also these AMPs can be used as an alternative for antibiotics in aquaculture.

Isolation and characterization of novel bacteriophage for biocontrol of bacterial diseases in fish

Bacteriophage therapy is an efficient eco-friendly and scientifically demonstrated solution to bacterial infections. In this project, pathogenic bacterial strains viz., *Flavobacterium columnare, Edwardsiella tarda, Aeromonas hydrophila* were obtained from ICAR-CIFE, Mumbai. Forty-six water samples from four sites of Mumbai were used for isolation of phages using standard procedure. Two *Aeromonas hydrophila* phages were isolated from analyzed samples. Bacteriophage titre of isolated phages were estimated by soft agar overlay technique. Host range of isolated phages were determined against various strains of bacteria. Hundred percent lysis was observed in all the bacterial strains. As the project advances more numbers of natural samples will be analysed for isolation of phages. Collection of more numbers of pathogenic bacterial strains from ATCC, MTCC and other institutes is already in progress. Moreover, analysis of phage nucleic acids, profiling of phage structural protein, genomic fingerprinting of isolated phages, and morphological characterization of phages by electron microscope will be done.

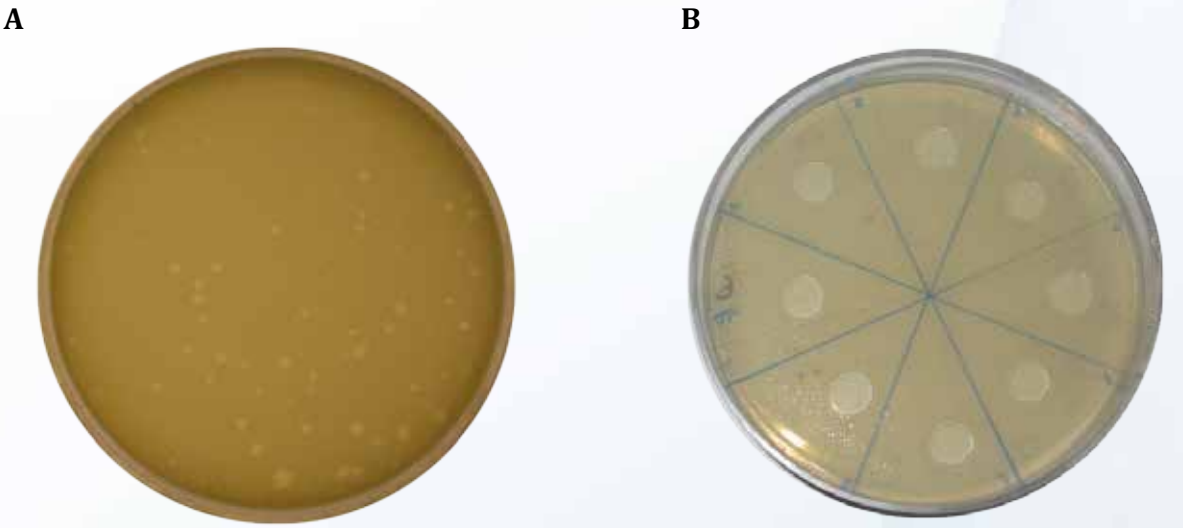

Fig 7: (A) Inhibition zone produced by *A. hydrophila*, and (B) Plaque formed by *A. hydrophila* phage

Identification and characterization of genes responsible for immune response in *Labeo rohita* fingerlings

Immuno-protection by dietary manipulation has emerged as an integral area of fisheries research. It is a safe and sustainable means for enhancing the non-specific immunity in fish. In this project we aim to delineate the expression analysis of some immune-responsive genes post dietary supplementation of microbial levan in *Labeo rohita* fingerlings challenged with bacterial infection. The database on the expression of various immune related gene in *L. rohita* post supplementation of levan would be useful to synthesize information in order to advocate and validate the usefulness of microbial levan as nutraceutical diet. The genes identified in this study can be used as diagnostic markers for identification of superior quality fingerlings.

OTHER PROJECTS

Isolation and characterization of root nodule bacteria from *Flemingia* sp.

Isolation of root nodule bacteria from *Flemingia macrophylla* and *Flemingia semialata* was carried out using YEM agar media. In total 49 and 28 bacterial isolates were obtained from the nodules of *F. macrophylla* and *F. semialata*, respectively. Identification of the bacterial isolates were achieved using 16s rRNA gene sequence analysis. The bacterial isolates mainly belonged to the genera *Bacillus*, *Rhizobium*, *Pseudomonas*, *Lycobactor* and *Ensifer*. These isolates were biochemically characterized and screened in in vitro conditions for their plant growth promoting properties including Indole-3-acetic acid production, potassium solubilization, zinc solubilization, siderophore production and urea utilization. On the basis of biochemical tests, 12 bacterial strains of different genera isolated from the root nodules of *F. macrophylla* were selected to develop an "efficient bacterial consortium". In addition to this, bacteria isolated from root nodules of *F. macrophylla* were also grouped genera-wise into different consortia (*Rhizobium* consortia, *Pseudomonas* consortia and *Bacillus* consortia). The "efficient bacterial consortium" was inoculated into the soil to validate its effect on growth of the plant and root nodule formation ability in *F. macrophylla*. Similarly, the performance of *Rhizobium* consortium, *Pseudomonas* consortium and *Bacillus* consortium was also assessed. The inoculation studies revealed that *Rhizobium* consortia increases the biomass of *Flemingia macrophylla* up to 40% and thus can be used as efficient bio-fertilizer for the production of healthy and quick growing *Flemingia* seedlings at nursery stage.

Fig 8: (A-B) Purified bacterial isolates from root nodule of *F. macrophyla*, and (C) 16s rRNA gene amplification from *F. macrophyla* root nodule bacteria

Fig 9: Two-month old *F. macrophylla* seedlings inoculated with bacteria isolated from *F. macrophylla* root nodules. Rows from left to right: 1 & 2 treatment with efficient consortium in non-sterile soil, 3 & 4 non-sterile soil control, 5 & 6 treatment with efficient consortium in sterile soil, 7,8,9 & 10 sterile soil control, 11 & 12 treatment with *Bacillus* consortium, 13 & 14 treatment with *Pseudomonas* consortium, 15 & 16 treatment with *Rhizobium* Consortium

Enhancing pure germinating seed yield of *Flemingia semialata* by physiological approaches

Plant growth regulators (PGRs) including thiourea (500 ppm, 1000 ppm, 1500 ppm), naphthaleneacetic acid (NAA) (15 ppm, 30 ppm, 45 ppm) and salicylic acid (100 ppm, 200 ppm, 300 ppm) were sprayed at pre flowering and anthesis stages of *Flemingia semialata* and their effects were studied on different morpho-physiological, physiological and biochemical characters. Plants sprayed with water were used as control. There were three replications for each treatment and the whole experiment was conducted in randomized block designs. The different morpho-physiological characters were studied at 15 d interval. Maximum plant height (2.37 m), stem diameter (19.25 mm), leaf area (90.50 cm^2), number of leaves (20.40), number of raceme/plant (11.2), floret number/ raceme (152.60), seed set % (67.0), 1000-seed weight (28.4 g) and seed yield (17.6 g/plant) was recorded with the application of thiourea (1000 ppm). However, maximum number of pods/raceme (129.1) and sturdiness (0.89%) was recorded with the application of thiourea (500 ppm) and NAA (30 ppm), respectively.

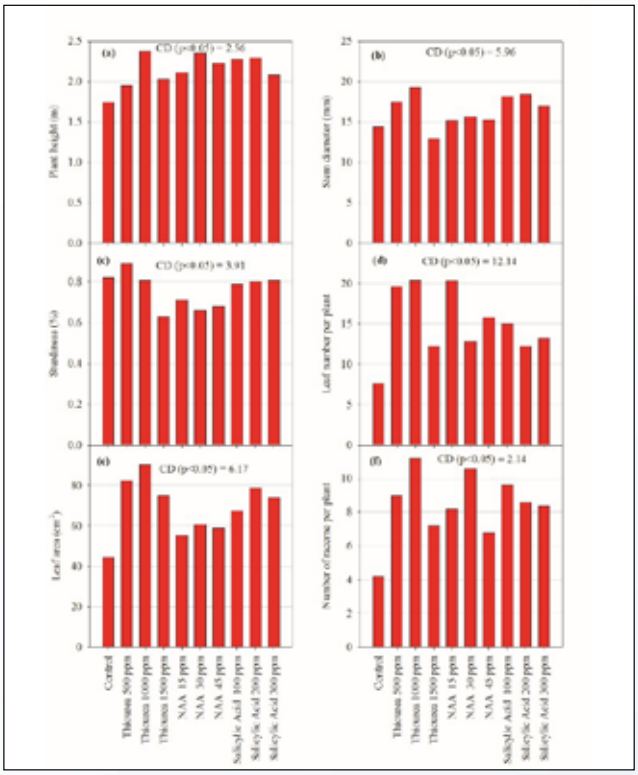

Fig 10: Effect of plant growth regulators on morpho-physiological character of *F. semialata*

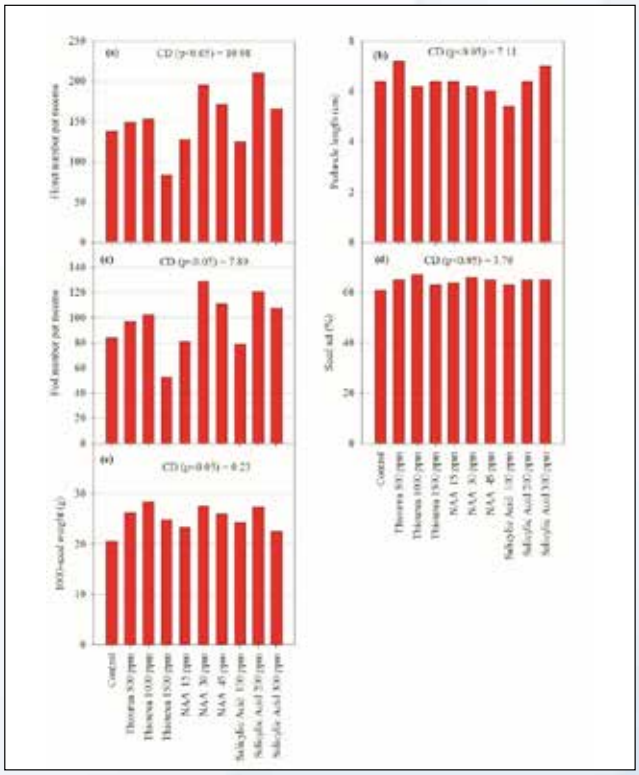

Fig 11: Effect of plant growth regulators on yield and yield attributes of *F. semialata*

The per cent seed set and pure seed yield were also improved by the application of different levels of PGRs. Maximum seed set (67.0 %) and seed yield (17.6 g/plant) were recorded in the plants treated with thiourea (1000 ppm).

Net photosynthesis rate and leaf stomatal conductance were measured in the fully expanded leaves of *F. semialata* in all the treatments using hand-held photosynthesis system (CI-340 CID, Inc., USA). Photosynthesis was expressed as µmol of CO_2 consumed m^{-2} sec^{-1} and stomatal conductance as mmol CO_2 consumed m^{-2} sec^{-1}. Among all the treatments, highest net photosynthesis rate (14.68) and leaf stomatal conductance (198.72), as compared to control (8.73 & 83.59), was recorded highest with the application of thiourea (1000 ppm).

Application of different levels of PGRs maintained higher relative water content (RWC) of leaves (56.46 - 42.94 %), leaf porosity (-14.12 to 12.92 %) and lower water saturation deficit (43.54 - 57.06 %) as compared to control (39.16, -21.68 and 60.84 % respectively). Application of thiourea (1000 ppm) recorded highest RWC (56.46%) as compared to control (39.16%). Further, water saturation deficit showed reduction with the application of PGRs in all the treatments. Lowest WSD (43.54) was observed with the application of thiourea (1000 ppm) with respect to control (60.84). Leaf porosity however showed increasing trend with the application of PGRs. Highest value of leaf porosity (12.92) was observed with the application of thiourea (1500 ppm) as compared to control (-21.68) in all the treatments. Lowering the water saturation deficit and increasing the relative water content and leaf porosity due to the application of PGRs resulted in higher seed set (67.0-63.0 %) as compared to control (60.91 %).

The application of PGRs also increased the chlorophyll and carotenoid contents. The highest values (3.14 µg/g fw and 0.52 µg/g fw, respectively) were recorded with the application of thiourea (1000 ppm). In summary, the study revealed that the application of PGRs improves seed set as well as seed yield in *F. semialata*. Among the different PGRs, thiourea (1000 ppm) is the most effective.

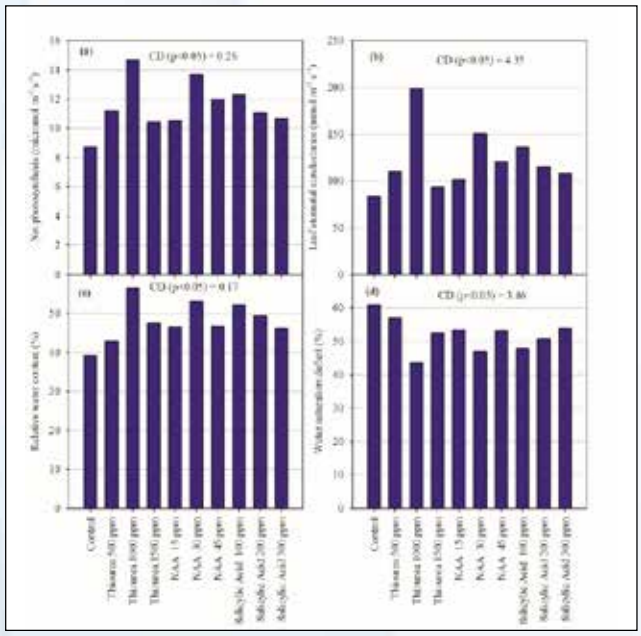

Fig 12: Effect of plant growth regulators on physiochemical and physiological attributes of *F. semialata*

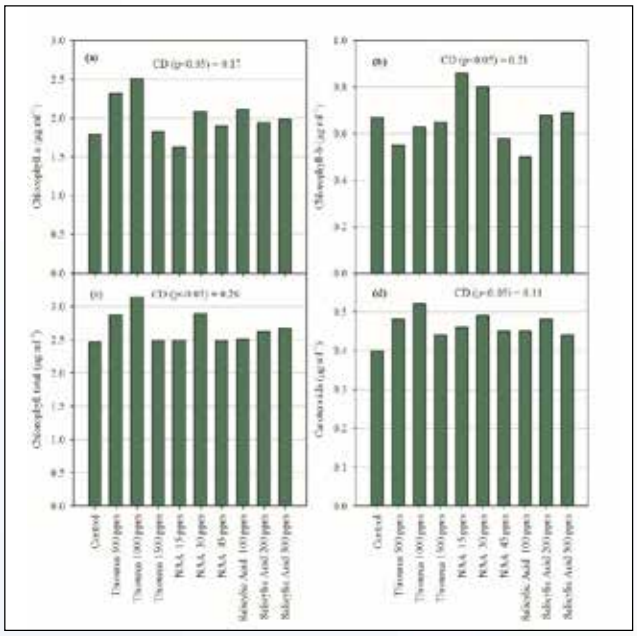

Fig 13: Effect of plant growth regulators on biochemical attributes of *F. semialata*

People's understanding of agricultural biotechnology in Jharkhand

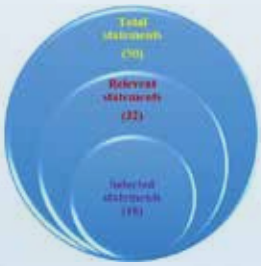

Fig 14: Statements in different stages of attitude scale development

Development of scale to measure attitude of people towards agricultural biotechnology

The method of summated rating suggested by Likert (1932) was followed for development of Attitude Scale. Fifty statements about agricultural biotechnology were collected out of which 32 statements were found relevant. Eighteen statements were finally selected for scale based on item analysis.

Development of Test to measure knowledge level of people about Agricultural Biotechnology

The procedure followed by Jha and Singh (1970) was used for development of Knowledge Test. Forty-five statements about agricultural biotechnology were collected out of which 34 statements were found relevant. Twenty statements were finally selected in item analysis based on item difficulty index (ranges from 30.00 to 83.33) and Item discrimination index values (ranges from 0.40 to 0.80).

Developed Attitude Scale and Knowledge Test would be used for assessing attitude and level of knowledge of stakeholders towards agricultural biotechnology.

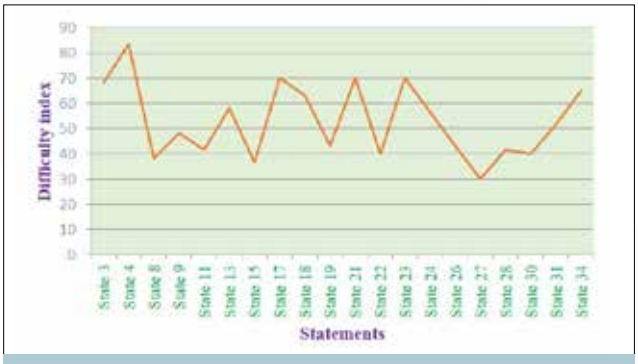

Fig 15: Selected statements for Knowledge Test and their 'Item Difficulty Index" values

Fig 16. Selected statements for Knowledge Test and their 'Item Discrimination Index" values

Zinc solubilizing rhizobacteria and arbuscular mycorrhiza fungi for bio-fortification in direct seeded rice

Effect of Zn solubilizing bacteria and arbuscular mycorrhiza fungi in enhancing Zn content in rice grain

The effect of Zn solubilizing bacteria (ZSB) alone and in combination with arbuscular mycorrhiza (AM) was studied to evaluate their potential to enhance Zn content in rice grains under direct seeded upland condition. The treatment with 75% recommended dose of fertilizers (RDF) + 25% N by FYM + ZSB + AM recorded maximum plant height (102.1 cm), panicle weight (2.2 g), 1000-grain weight (24.9 g), economic yield (27.3 q/ha), and Zn and Fe concentration in rice grain (35.3 and 21.2 mg/kg), respectively. It indicates that inoculation of Zn solubilizing strain along with AM and 75 % RDF with 25% N substituted by FYM has a potential of improving nutritional quality and yield in rice.

Response of lentil to biofertilizers under zero till condition in rice-lentil cropping sequence.

Fig 17: Effect of nutrient management practices on performance of direct seeded upland rice at anthesis (A) 75% RDF + 25% N by FYM + ZSB + AM, (B) Control, and (C) Rice crop at maturity

The experiment was conducted during 2015-16 to assess the effect of biofertilizers used as seed inoculation along with chemical fertilizer on the performance of lentil (cv. KLS 212) under zero-till rainfed upland condition of Jharkhand. Ten nutrient management practices were used viz., control; *rhizobium*; phosphate solubilizing bacteria (PSB); *rhizobium* + PSB; 50% recommended dose of NPK fertilizers (RDF-20:40:20 NPK Kg /ha) + *rhizobium*; 50% RDF+ *rhizobium* + PSB; 75% RDF+ *rhizobium*; 75% RDF+ *rhizobium* + PSB; 100% RDF + *rhizobium*; and 100% RDF+ *rhizobium* + PSB application, with three replications. Results revealed that seed inoculation with *rhizobium* and PSB along with 75% recommended dose of fertilizers yielded at par with 100% RDF + inoculation.

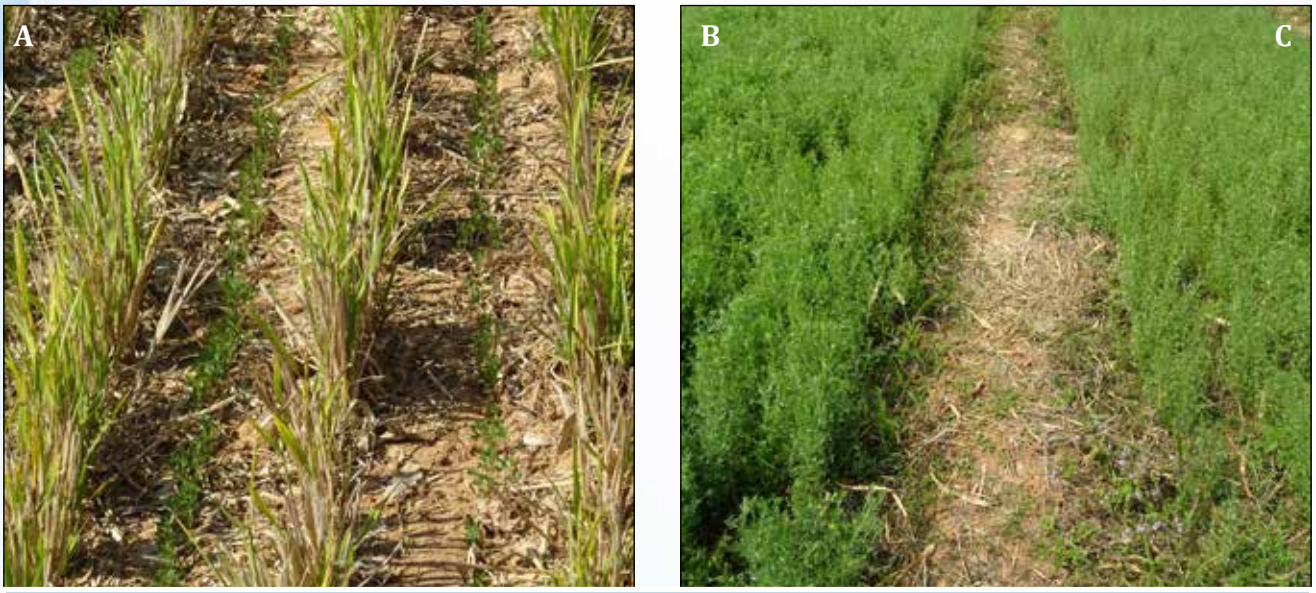

Fig 18. Emergence of lentil (A), and growth performance under zero till condition and 75% RDF + *Rhizobium* + PSB (B), zero till condition and 75% RDF + PSB (C), after rice harvesting

Construction of cDNA library of Indian lac insect, *Kerria lacca* and screening for genes involved in aleuritic acid biosynthesis

The project was successful in establishing the biosynthetic route of the aleuritic acid in Indian lac insect by fatty acid profiling of two distinct life stages of lac insect viz. crawler (resin non-secreting) and adult (resin secreting). The fatty acid profiling clearly indicated the presence of 9-hexadecenoic acid as a compound specific to adult lac insect stage. Aleuritic acid is chemically, 9,10,16-trihydroxyhexadecanoic acid. Therefore, a probable route of aleuritic acid synthesis was generated using the available gene information related to the hydroxylation of the hexadecanoic acid envisaging the involvement of fatty acid desaturase (FAD), epoxygenase (EPOX), epoxide hydrolase (EH) and monooxygenase (MONO). The analysis for these enzymatic activities using lac insect extract showed increased specific activity of three enzymes viz. FAD, MONO and EH at five fold, 10 fold and 24 fold respectively in adult lac insect in comparison to that of lac insect crawler. Based on enzymatic analysis and fatty acid profiling using GC-MS, a biosynthetic pathway for aleuritic acid was proposed for the first time in *Kerria lacca*. For identification of the lac insect specific genes involved in the process, a cDNA library was constructed using pGEMT vector and more than 8400 clones were isolated for the gene screening purpose. The library was screened for the four classes of genes viz FAD, EPOX, EH and MONO using degenerate primers, gene specific primers obtained through transcriptome analysis and full gene sequence of

related genes as probes. Southern blotting was performed using digoxigenin labelling technique and success was obtained in case of Epoxide hydrolase gene wherin a full-length ORF of 399 nucleotides was identified. The translated sequence of protein showed sequence similarity with an unidentified protein of *Acyrthosiphon pisum*, pea aphid with an e value of 6 x e-06. Pea aphid is the closest known genome available for lac insect, both falling under order Hemiptera. The sequence also showed sequence similarity with cytochrome P450 CYP153 alkane hydroxylase from an uncultured bacterium with 86 % identity. Therefore, this might be a novel sequence related to epoxide hydrolase from lac insect.

Small RNA profiling of the Indian Lac Insect, *Kerria lacca* (Kerr)

Wide variations exist between crawlers and adult female lac insects in terms of development and resin biosynthesis. Among different factors regulating the available variations, miRNAs are supposed to play an important and effective role in bringing out these variations. Therefore, in this study small RNA was isolated and sequenced from crawlers and mature female insects.

Neonate larvae of lac insects (crawlers) in replicates (C-1 and C-2) were collected from the Institute Research Farm of ICAR-IINRG, Ranchi and sent to Xcelris Labs Ltd, Ahmedabad in RNA later solution. At Xcelris labs, total RNA was isolated from the samples using Trizol reagent. The small RNA libraries from QC passed samples were prepared using Illumina TruSeq Small RNA kit from 1 µg of total RNA. The mean size of the fragment distribution was 150 bp and 155 bp for C-1 and C-2 sample respectively.

The libraries were sequenced using 1 X 75 chemistry to generate 60-65 million reads/ sample. A total of 67,969,503 and 109,377,788 reads were generated for C1 and C2 samples, respectively. Since the genome sequence of lac insect is not available, the draft genome of pea aphid, *Acyrthosiphon pisum* was used for the identification of known miRNAs in lac insect crawlers. To identify the known miRNAs and novel miRNAs, miRDeep2 software package was used. The module of miRDeep2 software maps the deep sequencing reads to predefined miRNA precursors and determines the expression of the corresponding miRNAs. A total of 7609 and 6605 known miRNAs were identified for C1

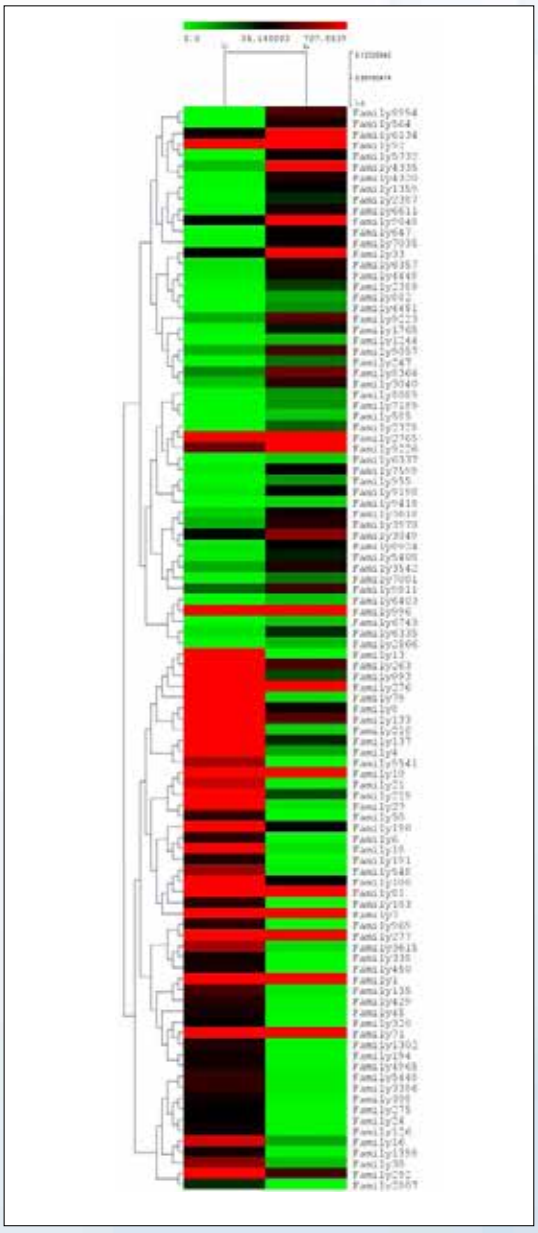

Fig 19: Heat map of differentially expressed miRNAs in crawlers and females of lac insects

and C2 samples, respectively. These miRNAs were aligned against publicly available mature miRNAs present in miRbase (v21.0) with two mismatches to identify the miRNA isoforms. In total 213 and 190 isomirs were identified in C1 and C2 samples, respectively. After filtering, 16 probable novel miRNAs were identified in lac insect crawlers. The targets for identified miRNAs were predicted in the whole transcriptome sequences of mature female lac insects. The target sequences of known miRNAs of C1 and C2 were annotated against nr protein database for functional annotation. Total of 25,189 and 29,039 targets were predicted for C1 and C2 known miRNAs respectively. Similarly, 896 and 915 targets were predicted for C1 and C2 novel miRNAs, respectively.

To identify the biological pathways in all the samples, the target sequences of miRNAs (25,189 target sequences from C1 known, 896 target sequences from C1 novel, 26,039 target sequences from C2 known, 915 target sequences from C2 novel, 19,656 target sequences from F1(female lac insects replicate1) known, 587 target sequences from F1 novel, 18,069 target sequences from F2 (female lac insects replicate 2) known, 512 target sequences from F2 novel) were mapped to reference canonical pathways in KEGG using KEGG automatic annotation server (KAAS). The mapped target sequences of miRNAs felled into broad categories such as, metabolism (eg. carbon metabolism, lipid metabolism), genetic information processing (transcription, translation, folding, sorting and degradation, replication and repair), environmental information processing (membrane transport, signal transduction, signalling molecules and interaction, transport and catabolism), cellular processes (cell motility, cell growth and death and cellular community) and organismal systems (immune system, endocrine system etc). A total of 506 families were significantly differentially expressed between crawlers sample vs adult female sample. Among them 419 families were significantly down regulated and 87 families were significantly upregulated.

INFRASTRUCTURE DEVELOPMENT

Establishment of Molecular Biology Laboratories

Since the construction of Laboratory Building of ICAR-IIAB is yet to start at Garhkhatanga, Ranchi, two fully air-conditioned molecular biology laboratories are being established in the building provided by ICAR-IINRG in its PDU Campus situated at Namkum, Ranchi. Four work benches and one laminar flow cabinet have been installed in the laboratories. Several essential equipment viz., autoclave, pH meter, top pan balance, refrigerators, electronic balance, microwave oven and deep freezers have already been procured. Procurement of specialized equipment required for molecular biology laboratories such as digital stereo zoom microscope, shaker incubator, thermocyclers, UV-Vis spectrophotometer, gel documentation system, refrigerated centrifuge, tabletop centrifuge, real-time PCR and ultra-deep freezers is under progress. To ensure uninterrupted power supply in the laboratories a 40 KVA automatic power generator has already been procured while the procurement of three 5 KVA UPS is under progress. Besides all these, a high speed (16Mbps) internet connection and three bioinformatics workstations are also in the process of procurement. All work places in the Institute are well connected with intercoms.

Fig 20: Molecular Biology Laboratory at ICAR-IIAB

Research Farm Development

Systematic development of research-farm at ICAR-IIAB was initiated by undertaking activities like extensive cleaning of heavy infestations of *Saccharum* sp. and cutting, filling and leveling of undulations. A total area of around 3.5 ha of cultivable land was prepared and sowing of wheat, maize and mustard was done. Area around the water sources of the farm was also cleaned to make them operational. To ensure continuous availability of water for irrigation and other farm related activities, groundwater prospecting in all the three farms of ICAR-IIAB was done by mapping of subsurface geological terrain, and in this endeavor six promising sites were identified and marked by iron pillars for drilling. Deep well boring at all these promising sites is in progress.

Fig 21: (A-C) Research farm development activities (D) Deep well boring going on at Farm B of ICAR-IIAB

Procurement of Farm Machinery

A 55 HP tractor (New Holland 5530 4WD) and farm implements like rotavator, seed cum fertilizer drill, cultivator, disc harrow, mould-board plough, land leveler, trolley, cage wheel etc have been procured and are being used for regular farm related activities.

Fig 22: Tractor and farm implements purchased by ICAR-IIAB (A) Keys of the tractor being handed over to the OSD, ICAR-IIAB, and (B) Farm implements

Establishment of Fish Wet Lab Facilities and Renovation of Fish Pond

Forty-six fiber reinforced plastic (FRP) tanks have been procured for taking up experimental trials related to fisheries research at ICAR-IIAB. In addition, a rainwater harvesting structure present in the Farm A of ICAR-IIAB has been renovated and converted into a fish pond. The pond was stocked with 2500 *Catla catla* and *Labeo rohita* fries to monitor its survival, growth performance and health condition in the pond environment.

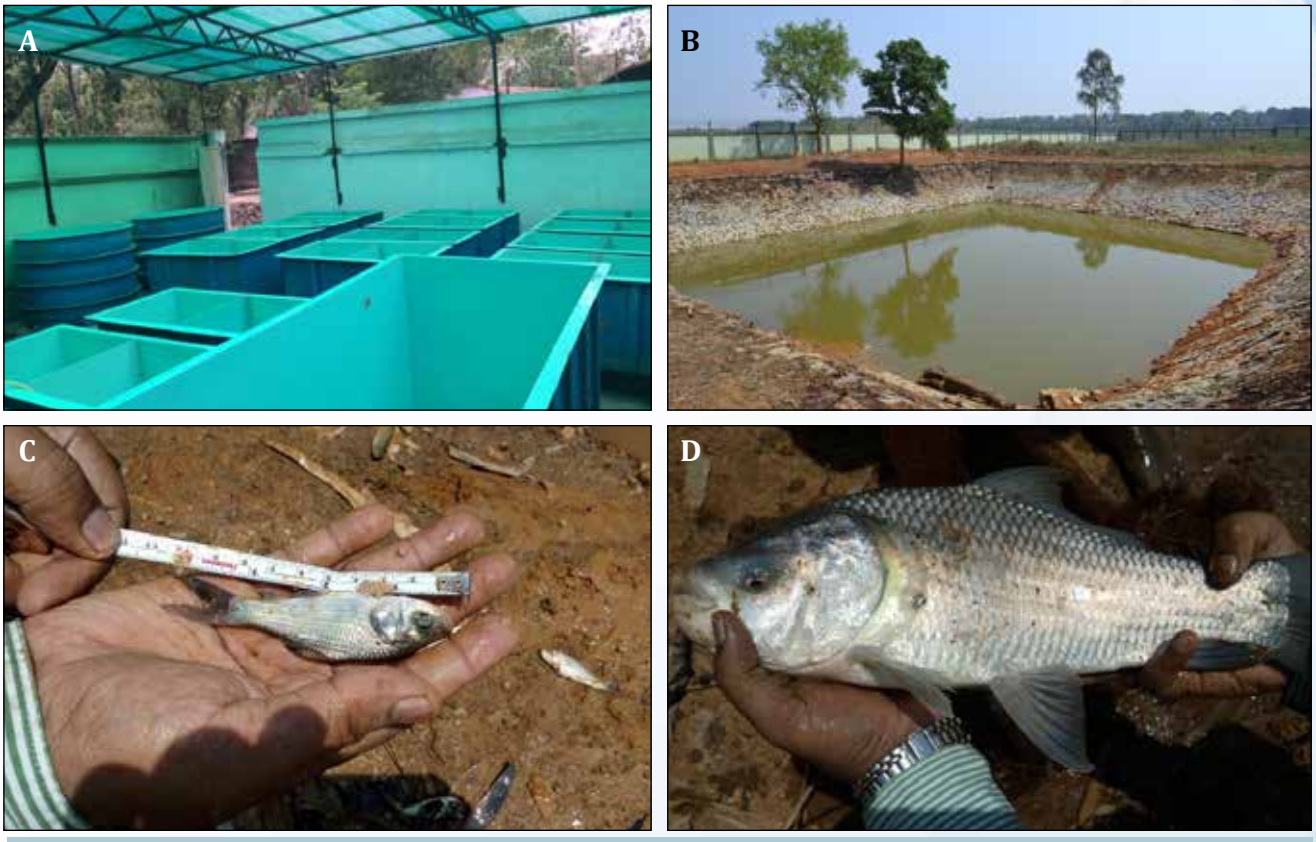

Fig 23: (A) FRP tanks, (B) Renovated fish pond, and (C-D) Monitoring of fish survival and growth performance in the renovated fish pond

Establishment of Library cum Committee Room

A Library cum Committee room has been established in the building provided by ICAR-IINRG, Namkum, Ranchi. For operational purposes, a conference table, chairs and racks were procured for the library. In addition, forty-three academic books and fifty Hindi books have also been procured. Institute library acquired lifetime membership of current science association, Bangalore and regularly receiving issues of "Current Science Journal" with effect from January, 2016. Besides, the library is receiving issues of "Journal of Plant Biochemistry and Biotechnology" and has subscribed Hindi and English newspapers for the benefit of staff of IIAB. Annual reports, vision documents, news-letters etc received from various ICAR institutes are also kept in Library.

Fig 24: Library cum Committee room of ICAR-IIAB

Conceptualization and Designing of Logo

With the technical advice of the Director, ICAR-Central Institute of Fisheries Education (CIFE), Mumbai, a logo depicting the essential domains of the institute has been designed. The conceptualization and designing of the logo was presented in the second Institute Management Committee (IMC) meeting of the ICAR-IIAB held on 14th March, 2016 and suggestions of the IMC members were sought for the improvement of the logo. After the suggestion logo was approved. In the logo of the institute components such as open book depicts education; plant, animal and fish depict the different areas of agriculture and double helical structure of DNA depicts biotechnology. The name of institute has been indicated in bilingual form in the logo.

Fig 25: Logo of ICAR-IIAB

INSTITUTIONAL ACTIVITIES

Personnel

Name, Designation & E. mail ID	Area of Research
Officer on Special Duty (OSD)	
Dr. T.R. Sharma, Director, ICAR-NRCPB, New Delhi iiab.osd@gmail.com	
School of Genomics and Molecular Breeding	
Dr. Vijai Pal Bhadana Pr. Scientist (Genetics & Plant Breeding) bhadanavijai@gmail.com	Molecular Breeding in Rice
Dr. Binay Kumar Singh Sr. Scientist (Agril. Biotechnology) binaybio@gmail.com	Genomics and Molecular Breeding for Enhancing Nutrient Use Efficiency in Rice
Dr. Anil Kumar Singh Sr. Scientist (Agril. Biotechnology) anils13@gmail.com	Genomics and Stress Physiology of Crops
Sh. Kishor U. Tribhuvan Scientist (Agril. Biotechnology) kish.tribhuwan@gmail.com	Genomics and Molecular Breeding for Abiotic Stress Tolerance in Pulse Crops
Sh. Shambhu Krishan Lal Scientist (Agril. Biotechnology) shambhumku@gmail.com	Genomics and Molecular Breeding for Enhancing Nutrient Use Efficiency in Rice
Dr. Vinay T.N. Scientist (Fish Genetics & Breeding) vinaytn56@gmail.com	Fish Immunogenetics and Vaccinology
School of Molecular Diagnostics and Prophylactics	
Dr. Biplab Sarkar Sr. Scientist (Nanobiotechnology) biplab_puru@yahoo.co.in	Development, and Application of Nanoparticles in Disease Control, Environmental Remediation and Micronutrient Induced Fortification
Dr. Sanjay Kumar Gupta Scientist (Fish and Fisheries) sanfish111@gmail.com	Fish Nutrigenomics

Sh. Tanmoy Gon Choudhury Scientist (Fish Health) tanmoygc@gmail.com	Fish Disease Prophylaxis and Therapeutics
Sh. Anutosh Paria Scientist (Fish Health) anu.cife@gmail.com	Molecular Immunology in Fish and Shellfish
Sh. Rishikesh Kumar Scientist (Plant Pathology) rishiiari2011@gmail.com	Host-Pathogen Interactions in Plant Disease
School of Basic and Social Sciences	
Dr. Nirmal Kumar Pr. Scientist (Agril. Extension) nirmaldr04@yahoo.com	Transfer of Technology and Impact Studies
Dr. Nawalesh Kumar Sinha Sr. Scientist (Seed Technology) nksinha.cazri@gmail.com	Seed and Environmental Physiology
Dr. Virendra Kumar Yadav Sr. Scientist (Agril. Extension) totdmr@gmail.com	Popularization of Agricultural Biotechnology
Dr. Seeta Ram Meena Scientist (Agronomy) sr.iari2010@gmail.com	Nutrient Management in Food Crops
Administration and Finance	
Sh. Y. Prabhakar prabhakarctri@gmail.com	Assistant Administrative Officer
Sh. Rishi Kant Singh singh.rishikant4@gmail.com	Assistant Finance & Accounts Officer

Training and Capacity Building

Details of trainings attended by the ICAR-IIAB staff during 2015-2016

S No	Name	Subject Area	Duration	Host Institute
1	Dr. Vinay T.N.	Professional Attachment Training	3 months (May 15 - August 14, 2015)	ICAR- National Institute of Veterinary Epidemiology and Disease Informatics, Bangalore
2	Sh. Anutosh Paria	Professional Attachment Training	3 months (May 15 - August 14, 2015)	ICMR-National Institute for Research in Reproductive Health, Mumbai
3	Sh. Tanmoy Gon Choudhury	Professional Attachment Training	3 months (May 15 – August 14, 2015	ICAR- Central Institute of Fisheries Education, Mumbai
4	Sh. S.K. Lal	Professional Attachment Training	3 months (August 1 – October 31, 2015)	ICAR- National Research Centre on Plant Biotechnology, New Delhi
5	Dr. S.R. Meena	Recent Advances in Enhancing Water Productivity in Hill and Plateau Region	21 days (September 25 – October 15, 2015)	Research Centre, ICAR-RCER, Plandu, Ranchi
6	Sh. Tanmoy Gon Choudhury	Molecular Biology and Biotechnology for Fishery	3 months (November 2 – January 30, 2015)	ICAR- Central Institute of Fisheries Education, Mumbai
7	Sh. Rishi Kant Singh	Management Development Programme on Public Procurement	6 days (November 30, 2015 - December 5, 2015)	National Institute of Financial Management, Faridabad
8	Dr. S.K. Gupta	Nutrigenomics Approaches in Fish Nutritional Research	11 days (December 8-18, 2015)	ICAR- Central Institute of Fisheries Education, Mumbai
9	Sh. Kishor U. Tribhuvan	Environmental Risk Assessment of Genetically Engineered Plants	2 days (February 22-23, 2016)	Ministry of Environment, Forestry and Climate Change, Govt. of India
10	Dr. A.K. Singh	Environmental Risk Assessment of Genetically Engineered Plants	2 days (February 22-23, 2016)	Ministry of Environment, Forestry and Climate Change, Govt. of India

Participation in Conferences, Meetings, Seminars, Symposia and Workshops

S No	Event	Venue	Period	Participants
1	National Seminar on Nutritional and Livelihood Security Through Vegetable Cultivation	Hazaribagh	June 27, 2015	Dr. Nirmal Kumar Dr. N.K. Sinha Dr. S.R. Meena
2	9th National Conference on KVKs	Patna	July 25-26, 2015	Dr. Nirmal Kumar Dr. N.K. Sinha Dr. V.K. Yadav Dr. S.R. Meena Sh. Kishor U. Tribhuvan Sh. S.K. Lal
3	National Symposium on Germplasm to Genes: Harnessing Biotechnology for Food Security and Health	New Delhi	August 9-11, 2015	Dr. N.K. Sinha Sh. Kishor U. Tribhuvan Sh. S.K. Lal
4	ISEE Golden Jubilee National Seminar on Strategy to Drive Skill Based Agriculture Development Forward for Sustainability and Rural Employability	BHU, Varanasi	November 5-7, 2015	Dr. Nirmal Kumar Dr. V.K. Yadav
5	XXIII International Grassland Congress	NCR, New Delhi	November 20 -24, 2015	Dr. S.R. Meena
6	National Conference on Biotechnology for Sustainable Development	BIT Mesra, Ranchi	December 17-19, 2015	Sh. S.K. Lal
7	International Symposium on Genomics in Aquaculture	ICAR-CIFA, Bhubaneshwar	January 28-30, 2016	Dr. S.K. Gupta Dr. Vinay T.N. Sh. Anutosh Paria
8	National Conference on Rural Livelihood Security Through Innovative Agri-entrepreneurship	Patna	March 12-13, 2016	Sh. Kishor U. Tribhuvan

Important Meetings

Institute Research Council (IRC) Meeting

ICAR-IIAB organized its 5th, 6th and 7th IRC meetings on April 21, 2015, September 1, 2015 and February 11, 2016, respectively. The Chairman of the 5th IRC meeting was the then OSD, ICAR-IIAB, Dr. R. Ramani while the 6th and 7th IRC meetings were chaired by the present OSD of ICAR-IIAB, Dr. T.R. Sharma. During the 6th IRC meeting Chairman stressed that establishment of laboratory and purchase of equipment should be the top priority of ICAR-IIAB. Accordingly, the Chairman advised the scientists to prepare a list of urgently required equipment and frame their specifications so that procurement process may be initiated. A total of four new research proposals and progress of three on-going institutional projects were presented in the meeting. For ensuring focused and result oriented approach in research, it was decided during the 7th IRC meeting that there will be three major programmes: (1) Genomics and bioinformatics, (2) Translational research for crop improvement, and (3) Biotechnological interventions for fish health management, that will comprise all the institutional projects. Accordingly, five new research proposals were presented in the meeting for comments and approval by the House. The OSD, ICAR-IIAB reaffirmed all support to the scientists for achieving excellence in their respective area of specialization. Further, he emphasized for better coordination among the scientists for achieving the best output in terms of product, technologies development or research publications.

[A] 7th IRC meeting at ICAR - IIAB, and [B] OSD, ICAR–IIAB interacting with the scietists during field visit

Research Advisory Committee (RAC) Meeting

The 3rd meeting of RAC of ICAR-IIAB was held at ICAR-IINRG, Ranchi during May 27-28, 2015 under the chairmanship of Dr. C.D. Mayee, Former Chairman, ASRB, New Delhi. Dr. J.S. Sandhu, DDG (Crop Science), ICAR; Dr. N.K. Singh, National Professor, ICAR-NRCPB, New Delhi and Dr. R. Ramani, OSD, ICAR-IIAB & Director, ICAR-IINRG, Ranchi attended the meeting as members of the committee. Dr. J.S. Chauhan, ADG (Seed), ICAR; Dr. T. Mohapatra, Director, ICAR-CRRI, Cuttack; Dr. R.K. Jain, Dean & Joint Director, ICAR-IARI, New Delhi and Dr. K.V. Prasad, Professor, Floriculture

[A] 3rd RAC meeting at ICAR - IIAB, and [B] RAC members performing field visit

& Landscaping, ICAR-IARI, New Delhi were the special invitees for the meeting. The RAC meeting started with the presentation of the PMC agency (MECON Ltd, Ranchi) regarding the updated master plan and drawings & designs of laboratories for ICAR-IIAB. Dr. Nirmal Kumar, Member Secretary made presentations on various agenda items including Action Taken Report (ATR) on the recommendations of the 2nd RAC, progress of the on-going institutional projects under the aegis of ICAR-IIAB and Vision 2050 document of ICAR-IIAB. After the deliberations, the ATR was accepted and minutes of the 2nd RAC meeting was approved by the House. Chairman and other members gave their advice on various aspects and appreciated the progress of developmental work done by OSD, ICAR-IIAB and his team. The DDG (Crop Science) and ADG (Seeds) went around all the ICAR-IIAB sites and were appraised about the layout of various buildings in the campus area.

Institute Management Committee (IMC) Meeting

[A] 2nd IMC meeting at ICAR - IIAB, and [B] Dr. S.R. Bhat interacting with the scientists of IIAB during field visit

The 2nd IMC meeting of ICAR-IIAB was held in the library cum committee room of ICAR-IIAB on 14th March, 2016 under the chairmanship of Dr. T.R. Sharma, OSD, ICAR-IIAB & Director, ICAR-NRCPB, New Delhi. The meeting was attended by the official members Dr. Shivendra Kumar, Former Head, Research Centre, ICAR-RCER, Plandu, Ranchi; Dr. S.R. Bhat, Former Professor & Principal Scientist, ICAR-NRCPB, New Delhi; Dr. (Ms.) Poonam Sikka, Principal Scientist, ICAR-CIRB, Hisar and Sh. Y. Prabhakar (Member Secretary). Dr. Nirmal Kumar (Principal Scientist), Dr. V.P. Bhadana (Principal Scientist), Dr. N.K. Sinha (Senior Scientist), Dr. B.K. Singh (Senior Scientist) and Sh. Rishi Kant Singh (AF & AO) from ICAR-IIAB were also present in the meeting as co-opted members of the IMC. During the meeting, discussions were held primarily in connection with (a) purchase of items which are not mentioned in EFC, and (b) revision of amount approved in EFC for the purchase of instruments. The Committee made specific recommendations in these regards for approval of ICAR.

Other Activities

Organization of Hindi Week

Hindi debate, extempore, essay writing, technical work writing, declamation, poetry recitation and noting and drafting competitions were organized for the staff of ICAR-IIAB during the Hindi Week celebrated from September 14-20, 2015. Prizes and certificates were distributed to the first three winners of the competition.

[A] Inauguration of Hindi Week, and [B] Staff of ICAR–IIAB participating in Hindi competitions

Organization of Hindi Workshops and International Yoga Day

Three Hindi workshops on (1) Yoga and Health (2) Pranayama and Health, and (3) Diabetes: Causes, Prevention and Cure, were conducted on September 30, 2015, October 01, 2015 and March 30, 2016, respectively at ICAR-IIAB. All the staff of ICAR-IIAB attended the workshops and benefited from the deliberations.

[A] Staff of ICAR–IIAB performing yoga exercises, and [B] Dr. Reema Khalkho acquainting the scientists of IIAB about diabetes

Group photograph of participants of Hindi Karyashala

Rajbhasha Implementation Committee Meetings

During the year 2015-16, a total of four Rajbhasha Implementation Committee meetings were conducted on May 23, 2015, September 30, 2015, December 31, 2015 and January 19, 2016, respectively. During these meetings the progressive use of Hindi in the official work was reviewed. To enhance the use of Hindi in their official work by the staff, Google Hindi software and Hindi fonts were installed in each computer of the Institute. Most of the official forms/formats were made available in Hindi. Hindi books were also procured for the ICAR-IIAB library.

Organization of Farmers' Awareness cum Training Programme

A one-day awareness cum training programme (under Mera Gaon Mera Gaurav Programme) on agricultural biotechnology was organized for the farmers on February 18, 2016 at Karge village of Mander Block of Ranchi. Around two hundred farmers participated in the programme and showed keen interest in the deliberations.

Farmers attending the training program at Karge village

Organization of Jai Kisan Jai Vigyan Week

ICAR-IIAB celebrated "Jai Kisan Jai Vigyan Week" during December 23 - 29, 2015 to commemorate the birth anniversary of two former Prime Ministers of India, Late Chaudhary Charan Singh and Sh. Atal Bihari Vajpayee. As part of the celebration, an exposure visit of fifty progressive farmers belonging to the village Tetri Dahutoli of Namkum block of Ranchi was organised on December 29, 2015. The farmers visited Birsa Agricultural University (BAU), Ranchi, Research Centre, ICAR-RCER, Plandu, Ranchi and ICAR-IIAB, Ranchi, and interacted with the scientists. The farmers were happy to see Agricultural Museum at BAU and showed keen interest in value added products, G-9 variety of banana, improved breeds of pig, nursery raising techniques in fruit orchard, mushroom cultivation, vermicomposting and plastic mulching in vegetable cultivation.

Different activities of Jai Kisan Jai Vigyan Week-2015, (A) Visit of farmers at ICAR-IIAB, Ranchi, (B) Visit of farmers at Pig Research and Training Centre, BAU, Ranchi, (C) Demonstration of mango nursery raising in Research Centre (RC), ICAR-RCER, Plandu, Ranchi (D) Demonstration of mushroom production in RC, ICAR-RCER, Plandu, Ranchi, (E) Demonstration of vermicomposting in RC, ICAR-RCER, Plandu, Ranchi, and (F) Demonstration of plastic mulching in RC, ICAR- RCER, Plandu, Ranchi

Organization of Swach Bharat Abhiyaan

ICAR-IIAB, in association with ICAR-IINRG, Ranchi, organized cleaning campaign in ICAR-IINRG campus and ICAR-IIAB office premises on April 10, 2015, May 08, 2015, October 9, 2015, October 17, 2015, and October 31, 2015. OSD, ICAR-IIAB & Director, IINRG, in a formal speech delivered to the staff of ICAR-IIAB and ICAR-IINRG, emphasized on bringing behavioral changes and spreading cleanliness awareness among people. He stressed that frequent cleanliness campaigns should be organized in and around the campus of ICAR-IINRG and office premises of ICAR-IIAB.

Cleanliness campaign of ICAR-IIAB under Swach Bharat Abhiyaan

Joining of New Staff

Name of the staff		Designation	Date of Joining
	Dr. T.R. Sharma Director, ICAR-NRCPB, New Delhi	Officer on Special Duty (OSD)	June 11, 2015
	Dr. Vinay T.N.	Scientist (Fish Genetics & Breeding)	April 9, 2015
	Sh. Anutosh Paria	Scientist (Fish Health)	April 9, 2015
	Sh. Tanmoy Gon Choudhury	Scientist (Fish Health)	April 13, 2015
	Sh. Kishor U. Tribhuvan	Scientist (Agril. Biotechnology)	April 13, 2015
	Sh. Y. Prabhakar	Assistant Administrative Officer	August 19, 2015
	Sh. Rishi Kant Singh	Assistant Finance & Accounts Officer	August 20, 2105
	Dr. S.K. Gupta	Scientist (Fish and Fisheries)	September 11, 2015
	Dr. B.K. Singh	Sr. Scientist (Agril. Biotechnology)	September 14, 2015
	Dr. A.K. Singh	Sr. Scientist (Agril. Biotechnology)	December 30, 2015
	Dr. V.P. Bhadana	Pr. Scientist (Genetics & Plant Breeding)	February 2, 2016
	Dr. Biplab Sarkar	Sr. Scientist (Nanobiotechnology)	March 28, 2016

Institutional Projects

Project Title	Date of Start	Principal Investigator	Co- Principal Investigator(s)
IIAB-CBB-01: Genomics and Bioinformatics			
IIAB-CBB-01-01: Identification and characterization of drought-responsive genes of wild chickpea (*Cicer microphyllum*)	April 2016	Dr. A.K. Singh	Sh. Kishor U. Tribhuvan Dr. V.P. Bhadana
IIAB-CBB-01-02: Identification of genes/QTLs for heat tolerance in lentil	April 2016	Shri Kishor U Tribhuvan	Dr. A.K. Singh Dr. B.K. Singh Dr. V.P. Bhadana Sh. S.K. Lal
IIAB-TRCI-01: Translational Research for Crop Improvement			
IIAB-TRCI-01-01: Introgression of genes/QTLs for drought tolerance and efficient phosphorus uptake in rice using MAS	April 2016	Dr. V.P. Bhadana	Dr. B.K. Singh Dr. A.K. Singh Dr. N.K. Sinha Sh. S.K. Lal Sh. Kishor U. Tribhuvan
IIAB-TRCI-01-02: Identification and functional characterization of genes/ QTLs responsible for Zinc homeostasis in rice	April 2016	Sh. S.K. Lal	Sh. Kishor U. Tribhuvan Dr. B.K. Singh Dr. V.P. Bhadana
IIAB-TRCI-01-03: Identification and mapping of novel genes/QTLs for phosphorus uptake and use efficiency in rice	April 2016	Dr. B.K. Singh	Dr. V.P. Bhadana Sh. S.K. Lal Sh. Kishor U. Tribhuvan
IIAB-FHM-01: Biotechnological Interventions for Fish Health Management			
IIAB-FHM-01-01: Development of nanoparticle based recombinant protein oral vaccine for Indian major carps against *Aeromonas hydrophila*	October 2015	Dr. Vinay T.N.	Sh. Tanmoy Gon Choudhury Sh. Anutosh Paria Sh. Kishor U. Tribhuvan Dr. S.K. Gupta
IIAB-FHM-01-02: Molecular characterization and functional analysis of antimicrobial peptides in response to pathogenic bacteria in striped catfish *Pangasianodon hypophthalmus*	October 2015	Sh. Anutosh Paria	Sh. Tanmoy Gon Choudhury Dr. Vinay T.N. Sh. Kishor U Tribhuvan Dr. S.K. Gupta

Project Title	Date of Start	Principal Investigator	Co- Principal Investigator(s)
IIAB-FHM-01-03: Isolation and characterization of novel bacteriophage for biocontrol of bacterial diseases in fish	October 2015	Sh. Tanmoy Gon Choudhury	Sh. Anutosh Paria Dr. Vinay T.N. Sh. Kishor U. Tribhuvan Dr. S.K. Gupta
IIAB-FHM-01-04: Identification and characterization of genes responsible for immune response in *Labeo rohita fingerlings*	November 2015	Dr. S.K. Gupta	Sh. Tanmoy Gon Choudhury Sh. Anutosh Paria Dr. Vinay T.N.
Other Projects			
1.5.001: Enhancing pure germinating seed yield of *Flemingia semialata* by physiological approaches	July 2014	Dr. N.K. Sinha	Dr. J. Ghosh (ICAR-IINRG) Dr. Md. Monobrullah (ICAR-IINRG) Dr. V.D. Lohot (ICAR-IINRG)
1.5.002: Peoples' understanding of agricultural biotechnology in Jharkhand	July 2014	Dr. V.K. Yadav	Dr. Nirmal Kumar
1.5.003: Zinc solubilizing *rhizobacteria* and *arbuscular mycorrhizal* fungi for bio fortification in direct seeded rice	August 2014	Dr. S.R. Meena	Dr. Thamilarasi K. (ICAR-IINRG) Sh. Kishor U. Tribhuvan Sh. S.K. Lal Dr. S.K. Naik (RC, ICAR-RCER, Plandu, Ranchi)
1.1.035: Isolation and characterization of root nodule bacteria from *Flemingia sp*	January 2014	Sh. Kishor U. Tribhuvan	Dr. Thamilarasi K. (ICAR-IINRG) Dr. V.D. Lohot (ICAR-IINRG)
FTP 001: Construction of cDNA library of Indian lac insect, *Kerria lacca* and screening for genes involved in aleuritic acid biosynthesis	January 2014	Sh. Anees K. (ICAR-IINRG)	NIL
FTP 002: Small RNA profiling of the Indian Lac Insect, *Kerria lacca* (Kerr)	January 2014	Dr. Thamilarasi K. (ICAR-IINRG)	Sh. Kishor U. Tribhuvan

Awards and Honours

1. Sh. Kishor U. Tribhuvan received Young Scientist Award - 2014 from Society for Upliftment of Rural Economy, Varanasi for his outstanding contribution in the field of Molecular Biology and Biotechnology.
2. Dr. Nirmal Kumar received O.P. Dhama Memorial Award - 2015 from Indian Society of Extension Education, New Delhi for his outstanding contribution in the field of Extension Education.
3. Dr. V.K. Yadav received ISEE Fellow Award - 2015 from Indian Society of Extension Education, New Delhi for his outstanding contribution in the field of Extension Education.
4. Dr. B.K. Singh received Best Scientist Award - 2015 from the ICAR- Directorate of Rapeseed-Mustard Research (ICAR-DRMR), Bharatpur for his outstanding achievement and contribution in research and overall growth of ICAR-DRMR.
5. Dr. S.K. Gupta joined as Editorial Board member of Global Journal of Fisheries and Aquaculture for 2015-16.
6. Dr. A.K. Singh joined as Review Editor of Frontiers in Plant Science.
7. Dr. T.R. Sharma serving as Chief Editor: Journal of Plant Biochemistry and Biotechnology.
8. Dr. T.R. Sharma serving as Sectional Editor (Biological Sciences), Current Science.
9. Dr. T.R. Sharma serving as Editor: Indian Journal of Agricultural Sciences
10. Dr. T.R. Sharma nominated to the Board of Directors, Biotech Consortium India Ltd. New Delhi.
11. Dr. T.R. Sharma nominated as Member Academic Council, University of Horticulture and Forestry, Solan (HP).
12. Dr. T.R. Sharma serving as a Member DBT-BIRAC Apex Committee, New Delhi.
13. Dr. T.R. Sharma serving as Member Advisory Committee of Himachal Pradesh Krishi Vishwavidalaya, Palampur (HP).
14. Dr. T.R. Sharma serving as Member, Institute Management Committee of Directorate of Maize Research, IARI, New Delhi.
15. Dr. T.R. Sharma serving as Member, Monitoring & Negotiation Committee of CeRA, ICAR, New Delhi.
16. Dr. T.R. Sharma serving as Member, Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops, Ministry of Agriculture, New Delhi.
17. Dr. T.R. Sharma serving as Chairman, Standing Committee of Courses Curricula & Academic Affairs, Post Graduate School, IARI, New Delhi.
18. Dr. T.R. Sharma serving as Member, Board of Studies of University School of Biotechnology, GGSIP University, New Delhi.
19. Dr. T.R. Sharma serving as Member, Scientific Advisory Committee of National Institute of Plant Genome Research (NIPGR), New Delhi.
20. Dr. T.R. Sharma serving as Member, Project Monitoring and Evaluation Committee of Department of Science and Technology, Govt. of India.
21. Dr. T.R. Sharma serving as Member, Committee for registration of EDV of Protection of Plant Varieties and Farmers Right Authority, Govt. of India, New Delhi.

Publications

Research Articles

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2. Choudhury TG, Singh SK, Baruah A, Das A, Parhi J, Bhattacharjee P & Biswas P. 2015. Reproductive features of *Puntius sophore* (Hamilton 1822) from rivers of Tripura, India. *Fish Technol* **52**: 140 - 144.
3. Dey S, Badri J, Prakasam V, Bhadana VP, Eswari KB, Laha GS, Priyanka C, Rajkumar A & Ram T. 2016. Identification and agro-morphological characterization of rice genotypes resistant to sheath blight. *Australas Plant Pathol* **45**: 145–153 *(DOI: 10.1007/s13313-016-0404-9)*
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7	Dr. K.V. Prasad	Professor, Floriculture & Landscaping, ICAR-IARI, New Delhi	May 27-28, 2015
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9	Dr. K.K. Sharma	Director, ICAR-IINRG, Ranchi	February 11, 2016
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