वार्षिक प्रतिवेदन
Annual Report 2014-15

भा.कृ.अनु.प.–भारतीय कृषि जैव प्रौद्योगिकी संस्थान

ICAR- Indian Institute of Agricultural Biotechnology

(Deemed to be University)

गढ़खटंगा, राँची, झारखण्ड

Garhkhatanga, Ranchi, Jharkhand

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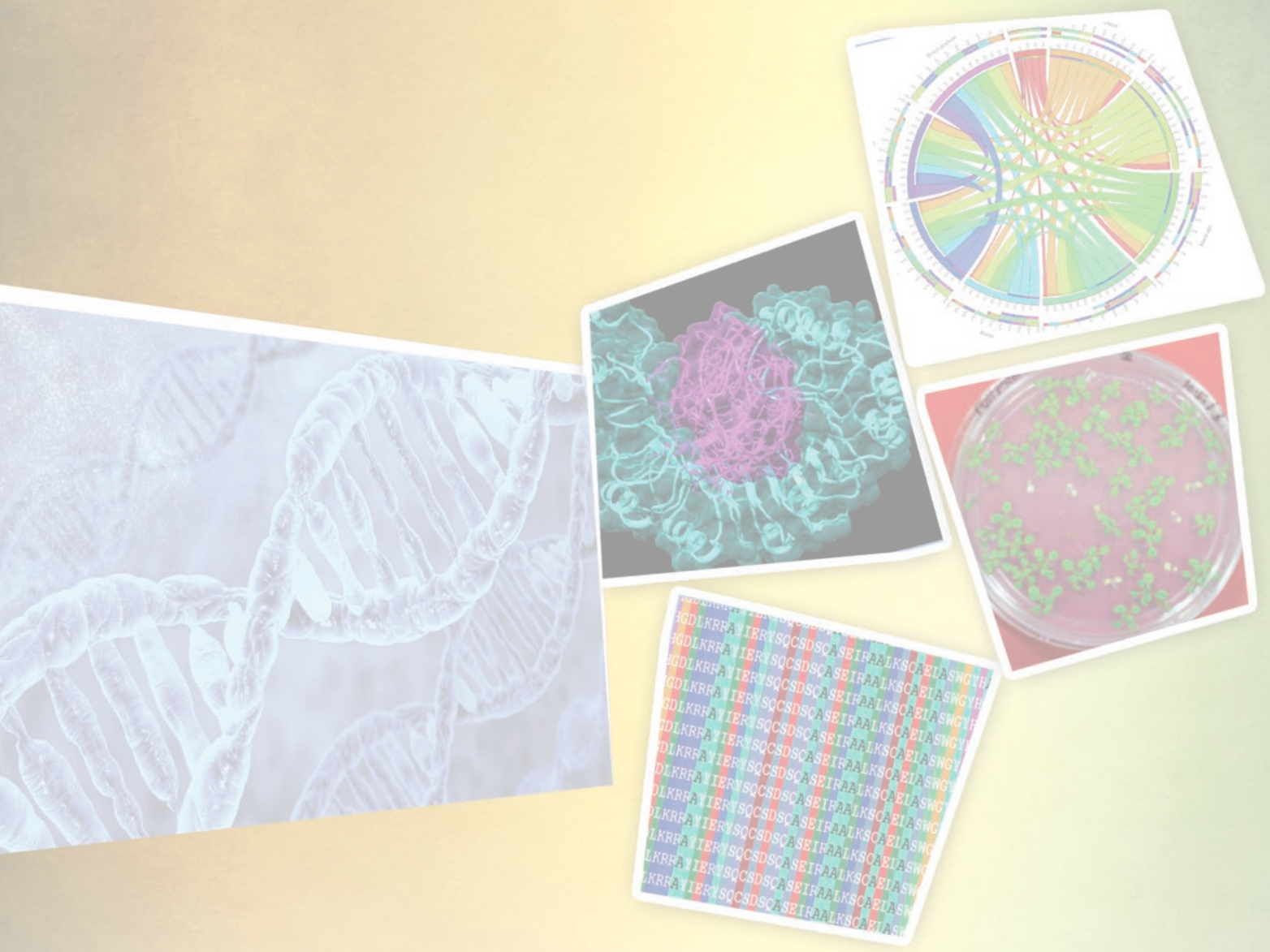

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Preface

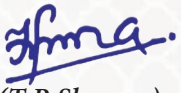
Indian agriculture is going through a transition phase as for as Agri-biotech products are concerned. The cultivation of Bt-Cotton in India has created history by covering more than 90% of the total area under cotton cultivation within a span of 10 years. It has been estimated that the income of the cotton growing farmers has increased from 14.6 million USD in 2001-02 to 2100 million USD in 2012-13. It clearly shows the impact of biotech interventions in crop improvement. Many more transgenic products are in pipeline which needs clearance from the GEAC (Genetic Engineering Appraisal Committee). I am sure, in future, India will also embrace GM Crops, like other countries cultivating Biotech derived crop varieties.

In the recent past genomics has been one of the most attractive areas of biotechnology across different species. *Arabidopsis thaliana* genome was unravelled in 2000 followed by the draft genome of both *japonica* and *indica sub species* of rice, the most important staple food of more than half of the world in 2002. Subsequently, the high quality genome sequence of *japonica* rice was published by the International Rice Genome Sequencing Project in 2005. Later, tomato, a representative species for half of the vegetable crops, was undertaken by the international research community for sequencing. Though tomato was initially sequenced with the traditional Sanger sequencing method, the development of Next Generation Sequencing (NGS) platforms provided a major thrust to sequencing efforts. In the recent past, NGS method has become an integral part of all whole genome sequencing projects. It has also enabled sequencing of bread wheat, the most important cereal crop next to rice, despite having a very huge and complex genome. Till date, more than 80 plant genomes have been sequenced and almost a new genome is being decoded every month. BGI (Beijing Genome Initiative) Research Institute has launched the 3-Million Genomes Project targeting millions of plant, animal and microbial genomes. Apart from whole genome sequencing, generation of transcriptome data has become a routine exercise, augmenting the resources to more than 75 million ESTs from around 25000 organisms in the NCBI dbEST domain. In spite of mega efforts on genome sequencing of important agricultural species are under way world over, India has yet to start such a mega genome project. Though, ICAR has started an ambitious "Genomics Platform" during the 12th plan to comprehensively consider different plants, animal, fish and microbial species for genome analysis across the domains, it will not be enough to cater to the need of a country like India which is so diverse in nature. In this context IIAB, which is a multi-commodity institute, will play a central role in future.

Human resource development in Agricultural Biotechnology would be one of the important mandates of IIAB. The institute will provide post-graduate and post-doctoral education in different areas of Genomics and DNA markers, Genetic Engineering, Nanobiotechnology, Diagnostics and prophylactics, which will help in developing skilled human resource in the country. I am sure with continued support from the council; the institute will be able to meet its targets.

This report is the account of past one year's progress of work done at IIAB, both at developmental and academic fronts. The foundation stone of the institute was laid by the Honourable Union Minister of Agriculture Sh Radha Mohan Singh ji on August 25, 2014. The

master plan of the institute has also been finalized to commence building construction work. The scientists of the institute have worked hard to complete some good work in collaboration with the Scientists of the Indian Institute of Natural Resins and Gums (IINRG), with modest facilities for doing biotechnological research. I am very thankful to all the scientists of IIAB for contributing to this report. I am thankful to Drs. Nirmal Kumar, Principal Scientist, N K Sinha, Sr. Scientist, V K Yadav, Senior Scientist & Mr Kishor U Tribhuvan, Scientist for compilation of the report. I am also indebted to Dr R Ramani, Former OSD of IIAB for completing most of the planning work of the Institute`s building and providing valuable guidance to scientists of the institute. I would like to place on record my sincere gratitude to Dr S Ayyappan, Secretary DARE and DG ICAR, Dr J S Sandhu, DDG (CS) and Dr J S Chauhan ADG (Seeds) and members of RAC and IMC for their help and guidance to meet the objectives of the institute.



(T R Sharma)

Officer on Special Duty, IIAB
& Director, NRCPB

Executive Summary

Indian Institute of Agricultural Biotechnology (IIAB) was established in 2012 having a camp office at the IINRG, Ranchi. The institute started functioning with a modest facilities and a few number of scientists from diverse subjects. In the beginning the biotechnological projects were continued as a part of the ongoing programmes of IINRG. The progresses of work done during the year under report have been summarized in the following paragraphs:

- A cDNA library of Indian lac insect has been constructed with 8520 clones and a possible biochemical pathway for the synthesis of aleuritic acid in lac insect has been proposed based on FAME analysis and enzymatic assays.
- Small RNA of the female lac insects, *Kerria lacca* has been sequenced using Illumina NextSeq platform. The miRNA families of 1736 have been identified in the female lac insects. Beside this, 35 probable novel miRNAs have also been predicted.
- Identified zinc solubilising bacteria belonging to *Bacillus*, *Pseudomonas*, *Enterobacter*, *Klebsiella and Serratia* genus of bacteria. Seven isolates were involved in phosphate solubilisation. Four isolates were involved in IAA production more than 50µg/ml when incubated for 96 hr.
- In *Flemingia semialata* among different plant growth regulators application, thiourea 1000 ppm was found more effective in seed set and seed yield. Preliminary results indicated that it may be because of high relative water content of leaves, high leaf porosity and low water saturation deficit.
- Based on judge`s opinion, 42 knowledge statements and 47 attitude statements were selected in relevancy test for developing knowledge test and attitude scale. List of few agricultural problems of Jharkhand which require agricultural biotechnology intervention was prepared.

Introduction

Agricultural production is facing serious constraints due to global climate change. There is thus need to develop climate resilient crop varieties. During post-independence, Indian agriculture has witnessed "Green revolution" in crop production and "White revolution" in milk production. However, with the increased demand for food and fodder because of the exponential growth in human and animal population, another green revolution is required by developing climate smart crops. For developing such designer crops, there is need of institutions which are equipped with world class infrastructure and trained human resource. ICAR-Indian Institute of Agricultural Biotechnology (IIAB) was strategically established by the Govt. of India at Ranchi on August 25, 2014 to meet the growing demand of agricultural products, processes and trained human resource in different areas of biotechnology. Once fully functional, the institute would meet the country's demand for quality trained personnel to foster the development in the agricultural biotechnology. Linkage with industries for research, sponsorship as well as for expert faculty will be in focus of the institute while planning the HRD programme. The teaching programmes developed will be flexible, dynamic and modular to ensure demand-driven availability of biotech academia for teaching, research and allied organisation/ industry. Regular HRD programmes like masters and doctoral degree, training modules, international exchange in the form of dual/sandwich modes will be in operation.

The institute will address the country's mission for a better and self-sufficient future in food sector by sensing the need in various facets of agricultural research. Biotechnological tools like molecular markers will be used as an integral and supplementary part future breeding programmes. In future various 'omics' approaches will used for decoding the genomes and transcriptomes of different plant, animal and microbial species, to search for novel genes and alleles important in Indian context. Custom made tool development for imparting specific qualities to target agriculturally important organisms is need of the hour to protect and refine the countries' traditional knowledge. Search for new genes and promoters will a foremost area of research to tap the unlimited biodiversity available in India for deployment in different crops species for the management of biotic and abiotic stresses. In future, transgenics plants will take the central stage in solving the food security and other problems related to farmers distress. 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 tailor-made agricultural crops with added beneficial components of the customers' (farmers') choice will be in place through technological 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 prime mandate of the institute. The need to increase the competence in computational biology with the help of multidisciplinary approach will be co-ordinated by the institute. A system for prophylactic measures to alleviate the vagaries of nature imposed on agricultural sector will be developed under the institute's leadership. A proper mechanism for intellectual property right protection, needs a special attention at policy and at implementation levels. 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. Huge potential and scope of nanotechnology in food processing, nano-sensors and nano-chips will be explored for the better environmental health and food security.

The institute will serve as a hub for biotech research activities undertaken by all institutes, with variety of mandate crops/animals, under NARS by providing technical support and service facility for products, tools, protocols, techniques, database, sequencing, bioinformatics, safety studies and knowledge. The institute will be dealing with the regulatory issues in biotechnology research, creating public awareness regarding the myths about biotechnology driven deliverables and its impact and acceptability among the rural/urban folk. The institute will act as central hub

among the scientists of different agricultural domains by providing support in handling the huge samples/data from the field with the help of high end facilities at the institute like robotics, automatic processing equipment and powerful data analysis facilities.

1. Mission

Strengthening of basic and applied research and human resource capacity building in the frontier areas of agricultural biotechnology and agricultural nanotechnology.

2. Mandates

- Serve as national institute of excellence in Agricultural Biotechnology for undertaking cutting edge research, post graduate, doctoral and post-doctoral education and capacity building
- Create platform for interaction and networking of national and international institutions for the application of Biotechnology in agriculture and provide appropriate support for policy framework.
- Forge partnerships with different stakeholders for the development and delivery of products and processes of Agricultural Biotechnology.
- Entrepreneurial and other relevant areas for furthering the application of Agricultural Biotechnology.

3. Genesis

Demand for agricultural produce is rising rapidly due to growing population, increase in per capita income and demand from the industry. On the other hand, agricultural productivity of the country is under stress due to enhanced burden on natural resources. Thus the nation is facing a dual challenge of attaining the production growth coupled with sustainability. While conventional approaches need to be suitably geared to deliver the desired output, the frontier areas of biotechnology, bioinformatics and nanotechnology could provide path breaking solutions to meet the above challenges. Biotechnological interventions that have already made global impact and offer scope for revolutionizing the agricultural production and farmer's income of the nation

It has been felt that the desired impetus to the biotechnology mediated revolution of agricultural research is constrained by lack of adequate trained human resources in agricultural biotechnology. Therefore, on the recommendation of Veerappa Moily committee, Indian Council of Agricultural Research (ICAR), the apex body for agricultural research in the country took the initiative to set up Indian Institute of Agricultural Biotechnology (IIAB). This institute, slated to be a deemed to be university interfacing plant, animal, fish and microbial biotechnology under a single umbrella. The IIAB will lay emphasis on the emerging areas of Genomics, Bioinformatics, Molecular Breeding, Molecular Diagnostics, Genetic Engineering and Nano-biotechnology for providing quality higher education.

4. Schools

The following schools have been envisaged in the EFC document of the Institute, encompassing all key areas of biotechnology for cutting-edge research and providing quality higher education.

- School of Genomics and Molecular Breeding
- School of Bioinformatics
- School of Genetic Engineering
- School of Molecular Diagnostics and Prophylactics
- School of Basic and Social Sciences

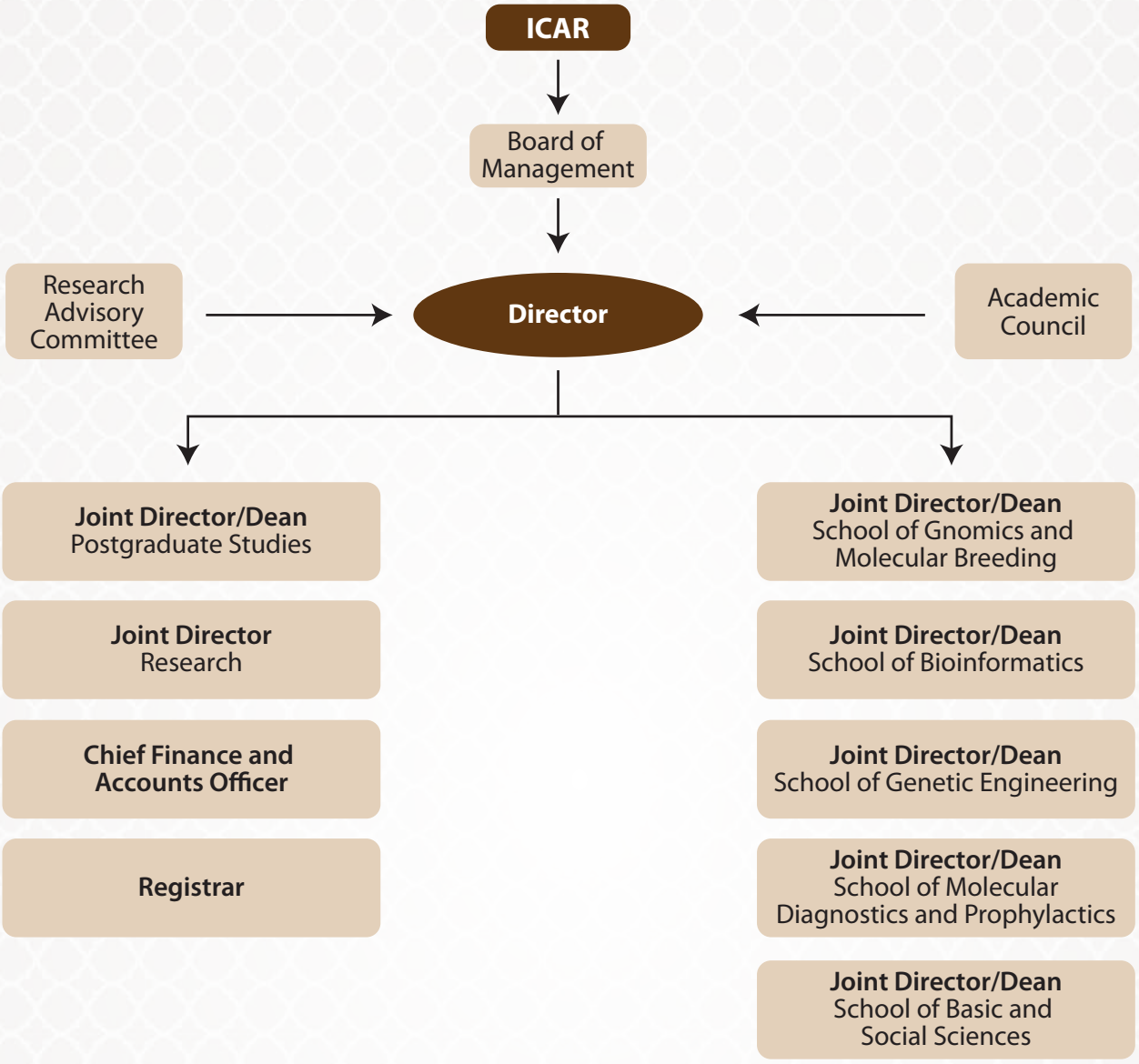
5. Courses

- Post graduate and Doctoral degree programmes in Biotechnology with specialization in different areas with fellowships support.
- Post doctoral fellowships in frontier areas of Biotechnology offered by the institute and accommodating fellowships sponsored by other agencies.
- Regular short, medium and long term training programs.
- International bridge degree programs, including dual / sandwich programs, etc.

6. Campus

A resident campus of the IIAB is located in Garhkhatanga, spread out in three locations viz., IIAB 1, IIAB 2 and

Organogram



IIAB 3 over an area of about 122 acres. Farm A (IIAB1) & Farm B (IIAB2) taken over from Head, ICAR Research Complex for Eastern Region Research Centre, Ranchi from Garhkhatanga area. Farm D (IIAB3) located in Lalkhatanga taken over from Scientist in Charge, ICAR-NBPGR Regional Centre, Ranchi. The land size of Farm A, Farm B and Farm D are 49.95, 54.31 and 17.29 acres, respectively. It is situated on the ring road close to Ranchi - Jamshedpur highway, about 15 km from Ranchi town. Ranchi, known for its salubrious climate and is emerging as a major educational hub with a number of flagship national institutions of academic excellence. The campuses will have all facilities of modern living students hostel and staff quarters.

Infrastructural development

Land designated for the Institute

- The land size of Farm A, Farm B and Farm D are 49.95, 54.31 and 17.29 acres, respectively totalling 121.55 acres.
- Connecting road of Farm A & B require 0.97acres of land out of which only 0.41 acres land is acquired and provided by the state govt. Process for acquiring remaining 0.56 acres of land by the land acquisition department, Jharkhand Govt. is in progress.

The foundation stone laying ceremony of IIAB was held by Sri Radha Mohan Singh ji, Hon'ble Union Minister of Agriculture. Govt. of India on 25th August, 2014.

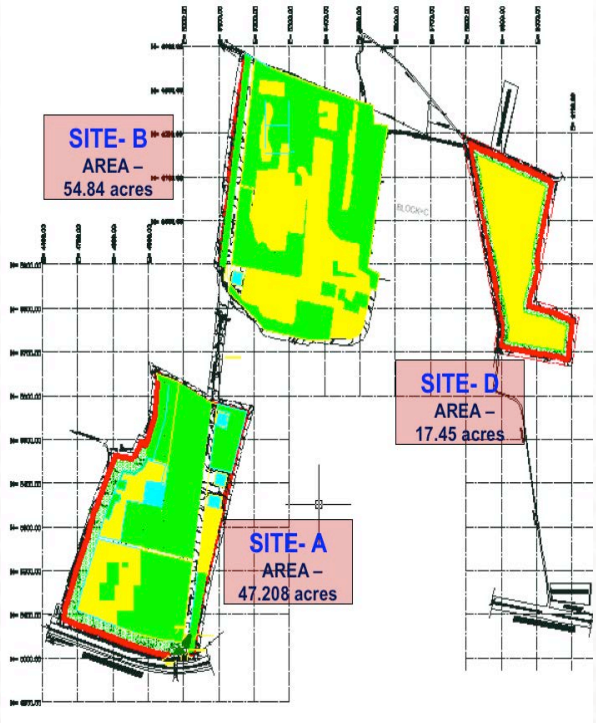
Master Plan of Site A of the IIAB campus

Campus of Proposed Indian Institute of Agricultural Biotechnology at Garhkhatanga, Ranchi

A campus is proposed for Indian Institute of Agricultural Biotechnology (IIAB) at Garhkhatanga, Ranchi, a unit of Indian Council of Agricultural Research (ICAR), Delhi.

The location of the Institute is as shown below.

ICAR-IIAB has three plots at Garhkhatnga namely site A, site B and site D. The site A is adjoining the existing ring road (6 lanes) enabling the proposed institute to have a good connectivity with the Ranchi city. The institute will be a green rated campus and it is proposed in the site A.



Research Accomplishments

1. Fast track project

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

This project aims to establish the biosynthetic route of aleuritic acid in Indian lac insect and tries to identify the genes involves in the process. For the confirmation of existence of pathway for aleuritic biosynthesis acid in Indian lac insect, fatty acid methyl ester (FAME) analysis of five different life stages of lac insect was carried out using GC-MS. Five lac insect life stages were selected for the study viz. crawler before settlement, after settlement, before fertilization, after fertilization and adult female, here after referred as stage 1, 2, 3, 4 and 5, respectively (fig. 1.1.1).

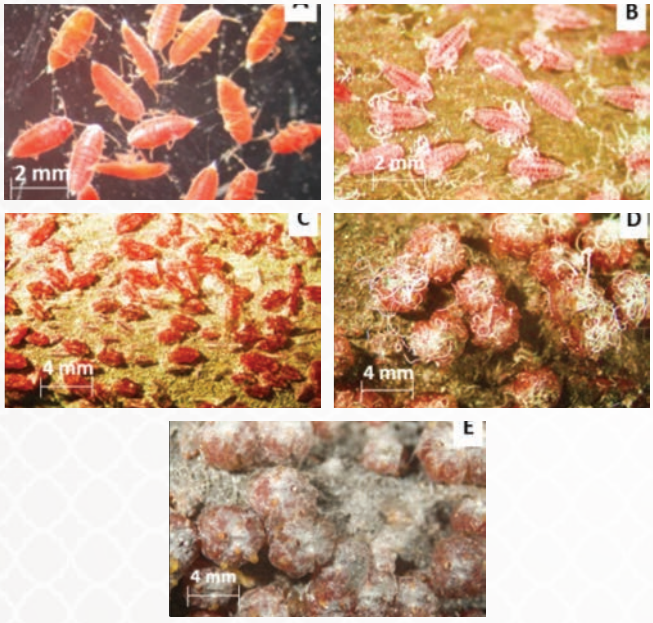


Fig. 1.1.1: Microscopic images showing various stages of lac insect life cycle A: Crawlers just after emergence (stage 1) B: Crawlers after settling (stage 2) C: Crawlers before fertilisation (stage 3) D: Lac insect after fertilisation (stage 4) E: Adult lac insect (stage 5)

Gas chromatography analysis of lac insect of all five stages detected various compounds viz. 9-tetradecenoic acid, tetradecanoic acid, 9-hexadecenoic acid, hexadecanoic acid, 9,12 Octadecadienoic acid, 9-Octadecenoic acid, Octadecanoic acid, 11-Cis-octadecenoic acid and Eicosanoic acid as listed in the Table1.1. 9-hexadecenoic acid was not detected in stage 1 and 2, while it was detected in significantly higher relative proportions in stages 3, 4 and 5 (fig.1.1.2). Another unique compound 9-tetradecenoic acid was detected only in stages 4 and 5. The relative proportion of 9-octadecenoic acids was found to be increased as the life stage progressed, which was in accordance with the reduction in relative content of octadecanoic acid (peak 4 fig.1.1.2). In all the three compounds mentioned, the common feature was a prominent appearance of unsaturated fatty acid in later life stages (stage 3-5). Since, aleuritic acid is 9,10,16 trihydroxyhexadecanoic acid, hexadecanoic acid was assumed as the precursor for its biosynthesis. Since fatty acid desaturation is a prominent event in the resin-secreting life stages of lac insect, fatty acid desaturase is most likely to be involved in its biosynthesis.

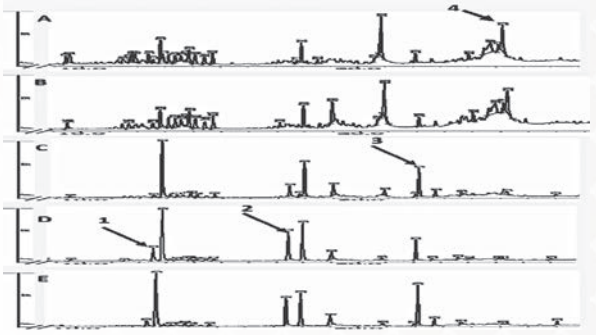


Fig.1.1.2: Gas chromatograms of five life stages of lac insect viz. stage 1 (A), stage 2 (B), stage 3 (C), stage 4 (D) and stage 5 (E). differential peaks expressed are indicated by arrow 1: 9-tetradecenoic acid 2: 9-hexadecenoic acid 3: 9-octadecenoic acid 4: octadecanoic acid

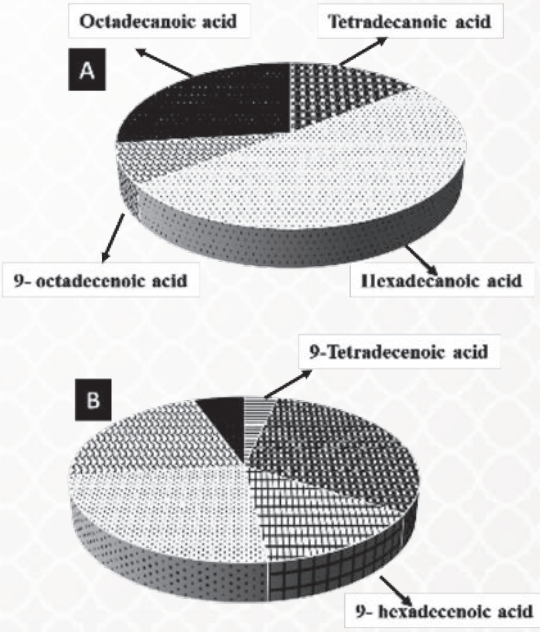


Fig. 1.1.3: Relative composition of major fatty acids in stage 1 (A) and stage 5 (E)

Two contrasting life stages with respect to resin secretion are stages 1 and 5. The relative composition of fatty acids in stage 1 and stage 5 reveals the absence of 9-tetradecenoic acid and 9-hexadecenoic acid in stage 1 (fig.1.1.3). Moreover, a 50% reduction in relative proportion of hexadecanoic acid was observed in adult lac insect (stage 5). From the FAME analysis, it was clear that 9-Hexadecenoic acid was present in the resin-secreting life stages of the lac insect (stage 2-5) when compared to that in resin non-secreting life stage (stage 1). Therefore, it was inferred that 9-Hexadecenoic acid might be one of the intermediate in the biosynthesis of aleuritic acid. A search for the biochemical reactions for fatty acid hydroxylation for the production of di/tri hydroxyl fatty acids (FA) was carried out and a probable involvement of four categories of enzymes viz. fatty acid desaturase, epoxygenase and epoxide hydrolase and monooxygenase which might contribute to the biosynthesis of aleuritic acid was found to be more important.

Table 1.1.1 : Retention time (RT) of FAMEs detected in all five stages

Sl. No.	Compound	RT (min.)
1	Methyl 9-tetradecenoic acid	12.5
2	Methyltetradecanoic acid	12.8
3	9-Hexadecenoic acid	17.4
4	Hexadecanoic acid, methyl ester	17.9
5	n-Hexadecanoic acid	18.9
6	Hexadecanoic acid, trimethylsilyl ester	20.8
7	9, 12-Octadecadienoic acid	21.9
8	9-Octadecenoic acid (z), methyl ester	22
9	Octadecanoic acid methyl ester	22.6
10	Octadecanoic acid	23.6
11	11-Cis-octadecenoic acid (z), methyl ester	24.8
12	Octadecanoic acid, trimethylsilyl ester	25.2
13	Eicosanoic acid, methyl ester	27

Considering the observation of GC-MS data and taking the help of reported biochemical reactions, a possible route for the biosynthesis of aleuritic acid was proposed (fig.1.1.4). The possible pathway has shown two routes for the synthesis of aleuritic acid. The first route with series of three monooxygenation reaction is most unlikely as the differential presence of 9-hexadecenoic acid was detected. If such a pathway does exist for aleuritic acid biosynthesis, the enzymatic activity of the proposed enzymes should be there in high proportion in resin-secreting life stages of lac insect. Therefore, lac insect extracts of various life stages selected was used for performing assays for fatty acid desaturase activity, epoxide hydrolase activity and monooxygenase activity. Fatty acid desaturase (FAD) activity was measured using hexadecanoic acid as a substrate and expressed as micrograms of cholesterol equivalents formed / (min. mg protein). Five-fold increase of FAD specific activity in adult insect extract when compared to stage 1 was observed, indicating the formation of the unsaturated fatty acid intermediate in resin secreting life stages of lac insect. Epoxide hydrolase activity, expressed as specific signal variation at 490 nm per milligram protein, exhibited about 10 fold increase in adult lac insect as compared to that in crawler. The biotransformation of indole and indole derivatives has been applied in selecting microorganisms expressing dioxygenase or monooxygenase activities due to the formation of indigo, a dark blue compound which is easily detected visually on agar plates. Monooxygenase activity, measured as micromoles of indigo formed / (min.mg protein) showed a significant increase of about 24 times in activity in stage 5 as compared to the previous four stages (fig.1.1.5).

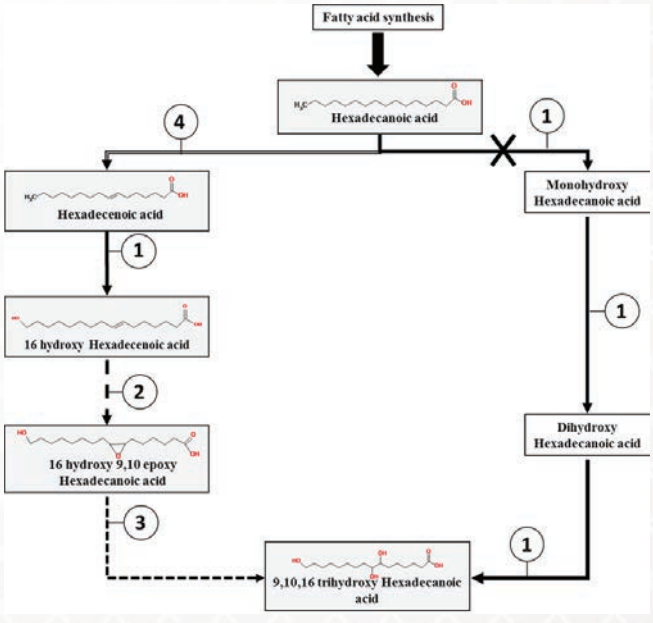


Fig. 1.1.4 : Possible biosynthetic route of aleuritic acid in Indian lac insect showing involvement of four category of enzymes viz. fatty acid desaturase (4), monooxygenase (1), epoxygenase (2) and epoxide hydrolase (3)

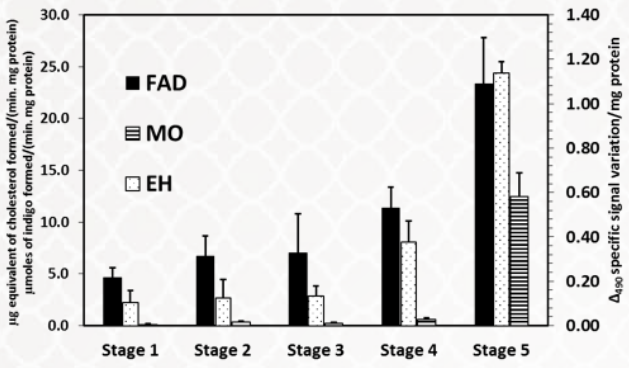


Fig.1.1.5 : Enzymatic activity of fatty acid desaturase (FAD, solid bar µg equivalent of cholesterol formed/ (min. mg protein)), monooxygenase (MO, striped bar, µmoles of indigo formed/(min. mg protein)) and epoxide hydrolase (EH, dotted bar Δ490 specific signal variation/ mg protein) of whole cell extracts of five stages of lac insect. FAD and MO plotted on primary axis and EH on secondary axis. Combining the results of enzymatic activity assays and GC-MS analysis the biosynthetic pathway for aleuritic acid has been proposed as given in fig.1.1.6.

This is the first report on the biosynthesis of the aleuritic acid in Indian lac insect. To confirm the proposed pathway, further studies will be conducted using inhibitors specific to the above mentioned reactions. Also, a separate study by using trans-supply of intermediate compounds and product profiling using GC-MS is being performed to endorse the findings.

Screening for genes involved : fatty acid desaturase (FAD)

The probe used for FAD gene screening was *FAD21* gene of *Glycine max* (gene accession no. 224440018). Five positive clones for fatty acid desaturase were identified by screening cDNA library (fig.1.1.7). The identified

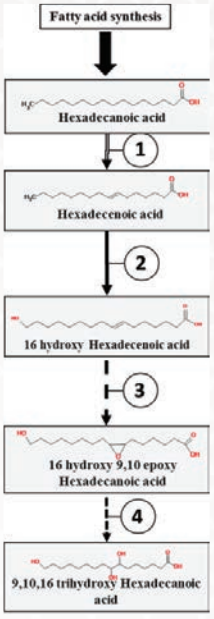


Fig. 1.1.6 : Proposed biosynthetic route of aleuritic acid in Indian lac insect showing involvement of four category of enzymes viz. fatty acid desaturase (1), monooxygenase (2), epoxygenase (3) and epoxide hydrolase (4)

putative colnes of fatty acid desaturase from cDNA library screeening were used as template to amplify the putative genes using oligo dT/oligo dG primer set. Amplicons of six different sizes (500bp, 700bp, 800bp, 900 bp, 1.4 kb and 1.5 kb) were extracted from gel for cloning in pGEMT Easy vector (fig.1.1.8). Restriction digests of *FAD* positive clones using *EcoRI* are shown in fig. 1.9. So far, the sequencing of these positive clones gave no gene sequences related to fatty acid desaturase. Since this approach did not gave any real clones which contains FAD sequence, alternative approach is being tried. In this, degenerate primers, designed based on the conserverved sequences among three types of *FAD* genes viz. plant type, aphid type and fungus type are being used to amplify the *FAD* specific sequences. The list of degenarte primers designed for this purpose is given in table 1.1.2 .

Table 1.1.2 : List of degenerate primers designed for amplification of *FAD* gene

Sl. No.	Primar Name	Sequence
1	Aphid FAD FP:	5'TGCACCAYAARTWSYGASACCRAYGSTG 3'
2	Aphid FAD RP:	5'GTAGTCCCAKGGGAAYRCGTGGTG 3'
3	Plant FAD FP:	5'TTYTCMSASWACWAMRKTGSTSGAMGACAT 3'
4	Plant FAD RP:	5' GKGTGWWGTTRKGSAWYCYTTSTTGAGGA 3'
5	Protofungus FAD FP:	5'GCAACAGKGYGGYTGGCTKCAYGATTTC3'
6	Protofungus FAD RP:	5'GTGATGCTCSAKYTGRTASTKCAWKCCACC 3'

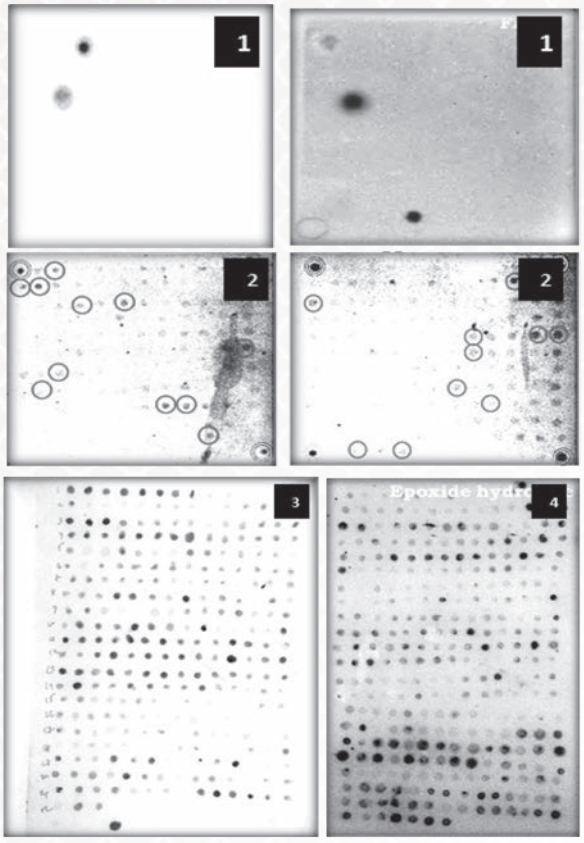


Fig. 1.1.7 : Primary screening of cDNA library for four genes 1: Fatty acid desaturase; 2: monooxygenase; 3: epoxygenase; 4: epoxide hydrolase

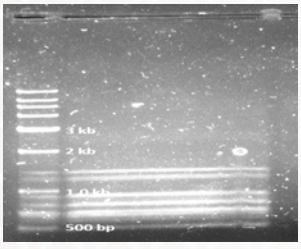


Fig.1.1.8 : PCR amplification of FAD positive clones using oligodT/oligodG primers

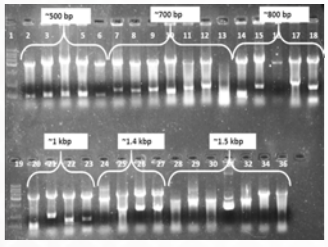


Fig.1.1.9 : Restriction digestion of the recombinant clones of FAD (for various sizes of inserts) in pGEMT Easy vector using *EcoRI*

Screening for epoxygenase

The primary screening using degenerate primers 59 positive clones identified (fig.1.1.7). These 59 clones were subjected to secondary screening, wherein, these plasmids were used as template to oligodT/oligodG primer set to amplify the inserts. The amplicones were resolved on 1% agarose gel and was again subjected to southern blotting using the same degenerate primer as probe (fig. 1.10). The putative band showing complementarily to the probe was taken for cloning in pGEMT vector. The sequencing of these clones did not give any positive result. The cloning of other size of inserts are in progress.

Screening for epoxide hydrolase

Degenerate primers were designed for the cDNA library screening based on the conserved HGXP motif considering 42 reported epoxide hydrolase sequences. Accordingly a degenerate primer which corresponds to the amino acid sequence HGw/fPGSW was designed for primaryscreening (5'CAYGGNTKBCCNGRNHBNTKB 3'). Primary screening using this primer gave 22 putative clones (fig.1.1.7). 22 putative clones were selected for secondary screening and two putative inserts (of size~750bp and~600bp) were selected for cloning in pGEMTvector The cloning was confirmed by restriction digestion with EcoRI. The clones were send for sequencing and the results obtained were not matching with reported epoxide hydrolase sequences. The cloning and sequencing of the other putative inserts are in progress.

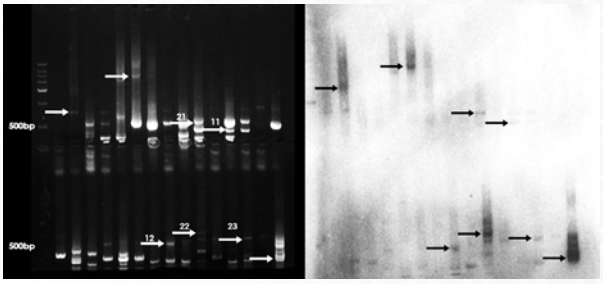


Fig.1.1.10. Secondary screening for epoxygenase gene. 1% agarose gel showing the amplicons (A) of first 30 putative clones and the corresponding southern blot (B). arrow indicated the putative bands for epoxygenase

Screening for monooxygenase

Since monooxygenase gene is a diverse family, it was not easy to design a single degenerate primer for screening. Therefore two *CYP450* genes viz. *CYP77A6* (which catalyses the reaction of converting 16-hydroxy palmitic acid to 10,16-dihydroxypalmitic acid in *Arabidopsis thaliana)* and another *Cytochrome P450* gene from *Leishmania donovani* designated as LD34CYP450 were used as probe for screening. 22 clones were obtained positive using LD34CYP450 as probe, while 8 positive clones were obtained using CYP77A6 as probe (fig. 7). The secondary screening of these putative clones will be carried out using indole screening method, wherein, the inserts from these clones will be directionally re-cloned in pET28 vector. These clones will be induced using IPTG and will be incubated in a media containing indole, a broad-spectrum substrate for monooxygenases. The positive clones will convert indole (colourless) in to dark blue coloured indigo.

1.2 Small RNA profiling of the Indian lac insect, *Kerria lacca* (Kerr)

MicroRNAs (miRNAs) are a class of small non-coding RNA molecules, which play important roles in gene expression at post-transcriptional stage. They negatively regulate gene expression either by mRNA cleavage or translational repression. miRNAs have been demonstrated to be involved in growth, cell differentiation, apoptosis and immune response, *etc* in insects. miRNAs were identified usually by molecular cloning and sequencing technologies. These methods tend to be highly biased towards abundantly and/or ubiquitously expressed miRNAs. More recently, the newly developed deep sequencing technologies have been used to detect miRNAs, which is a very effective method for the large-scale discovery of small non-coding RNAs, especially in identifying poorly expressed or species-specific miRNAs.

In this study, different developmental stages of the Indian lac insect, *Kerria lacca* viz., crawlers and mature female insects have been selected for sequencing small RNAs following next generation sequencing techniques. Wide variation exists between crawlers and adult female lac insects in terms of development and resin biosynthesis. Among different factors regulating the variations, miRNAs are supposed to play an important and effective role in bringing these variations. Hence these two stages were selected for studying their roles in development and resin biosynthesis of lac insects.

Mature female lac insects in replicates (F-1 and F-2) were collected from the lac insect gene bank at Institute Research Farm of ICAR-IINRG, Ranchi. After removing resin, the female lac insects were sent to Xcelris Labs Ltd in RNA later solution. Total RNA was isolated from the samples using Trizol. The small RNA libraries from QC passed samples were prepared using Illumina Trueseq Small RNA kit from 1 µg of total RNA. The mean size of the fragment distribution is 155 bp and 154 bp for F-1 and F-2 sample respectively.

The libraries were sequenced using 1 X 75 chemistry to generate 60-65 million reads/sample. A total of 73793548 and 104028121 reads were generated for F1and F2 samples, respectively. Since the genome of lac insect is not available, the draft genome of pea aphid, *Acyrthosiphon pisum* (related to lac insect and whole genome sequence is available) was downloaded and used for identification of known miRNAs in lac insects. 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 by that the expression of the corresponding miRNAs. A total of 3924 and 4932 known miRNAs have been identified for F1 and F2 samples. These miRNAs were classified into various families. A total of 1736 common miRNA families were identified between two samples of F1 and F2.

Simultaneously these miRNAs were aligned against publicly available mature miRNAs present in miRbase (v21.0) with two mismatches to identify the miRNA isoforms. Simultaneously 76 and 83 isomirs were identified in F1 and F2 samples, respectively. After filtering, 35 probable novel miRNAs were identified in female lac insect samples. The targets for identified miRNAs have been predicted in the whole transcriptome sequences of mature female lac insects. The F1 target sequences of known miRNAs were annotated against nr protein database for functional annotation. From total of 19,656 targets predicted out of which 19,226 were found to have annotation. Out of this, 6,530 were unique targets from the annotated targets. Simultaneously for 587 targets predicted out of which only 533 were found to have their annotation for F1 novel miRNAs. Out of this, 277 unique targets were found from the annotated targets. The F2 target sequences of known miRNAs were annotated against nr protein database for functional annotation. From total of 18,069 targets predicted out of which only 17,608 were found to have their annotation. Out of this 6,323 unique targets have been found from the annotated targets. Simultaneously for 512 targets predicted out of which only 470 were found to have their annotation for F2 novel miRNAs. Out of this 296 unique targets have been found from the annotated targets. Quantitative RT PCR will be carried out for the predicted novel miRNAs to validate the results in female insects. The crawlers stage of the lac insects will also be taken up for small RNA sequencing and the comparisons will be done between miRNA population of adult female and crawlers to find out differentially expressing miRNAs.

2. Institute Project

2.1 Identification of Zn solubilising rhizobacteria and arbuscularmycorrhizal fungi for biofortification in direct seeded rice

Rice rhizospheric soil samples were collected from Hazaribagh, Khunti, Torpa and Ranchi regions of

Jharkhand for isolation of Zinc Solubilizing Bacteria (ZSB). The protocol for isolation of ZSB was standardized. Total 150 ZSB were isolated on the basis of formation of hallow zone around the bacterial colony using zinc oxide in modified Bunt and Rovira medium. Among the isolated 150 ZSB, 20 efficient ZSB were selected for molecular identification and biochemical analysis. 16S rRNA gene was amplified using 8F and 1492R primers and sequenced. Bioinformatics analysis of sequencing result were carried out and 11 bacterial isolates were identified (table 2.1.1). Biochemical analysis of isolated bacterial isolates also performed to analyse it capacity for production of IAA, secretion of acids and phosphorus and potassium solubilisation (Table 2.1). IAA production of 11 ZSB isolates were carried out using LB medium supplemented with 50µg/ml tryptophan. It is found that four isolated ZSB were involved in IAA production more than 50µg/ml when incubated 96hr. pH analysis of selected ZSB isolates were showed decrease in pH up to 3.3 from initial pH 6.5. Result of phosphate solubilisation test reveal that 7 ZSB isolates were involved in phosphate solubilisation. There were no ZSB colonies out of 11 were involved in potash solubilisation.

Table 2.1.1 : Molecular identification and biochemical analysis of efficient strains of ZSB isolated from rice rhizosphere

Sr. No	ZSB Colony Name	Name of the bacterial isolates	IAA Concentration at 96 hr of incubation (µg/ml)	P Solubilization	K Solubilization	Decrease in pH (Initial pH 6.5)
1.	KG 14	*Serratiamarcescens*	40	++	-	5.3
2.	RD 1	*Bacillus sp*	106	+	-	4.85
3.	DBG 4	*Pseudomonas sp*	22	-	-	4.84
4.	DBG 5	*Pseudomonas sp*	56	-	-	4.9
5.	CK4	*Enterobactersp*	07	+	-	4.8
6.	DBG 1	*Enterobactersp*	77	+	-	4.9
7.	RG 8	*Bacillus cereus*	102	-	-	4.77
8.	KG 8	*Klebsiellavariicola*	00	+	-	4.08
9.	RG 7	*Bacillus cereus*	38	+	-	4.7
10.	ZS 6	*Enterobactersp*	15	++	-	4.8
11.	DBG 7	*Psudomonassp*	-	-	-	3.4

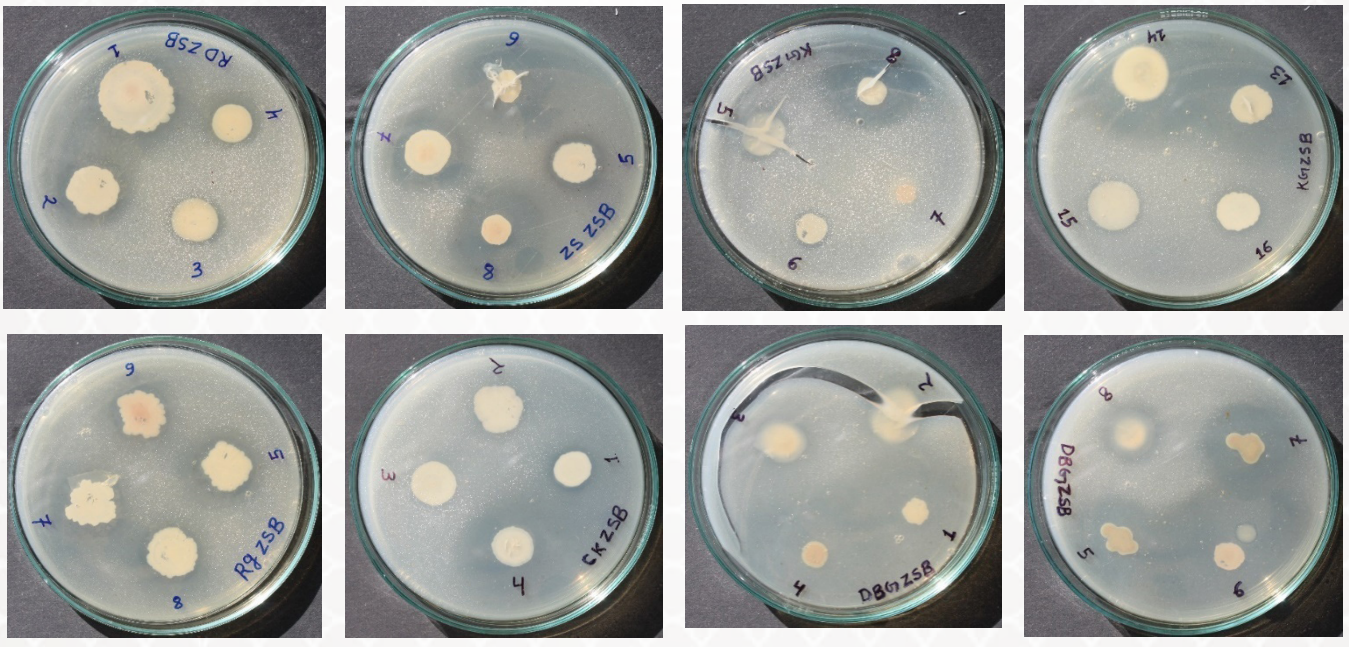


Fig .2.1.1: Zinc Solubilizing Bacterial isolates isolated fron rice rhizosperic soils.

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

In the first year different concentrations of Plant Growth Regulators (PGRs) such as T_1- Control (water); T_2- Thiourea 500 ppm, T_3 – Thiourea 1000 ppm, T_4 – Thiourea 1500 ppm, T_5 – NAA 15 ppm, T_6 – NAA 30 ppm, T_7 – NAA 45 ppm, T_8 – Salicylic acid 100 ppm, T_9 – Salicylic acid 200 ppm, T_{10} – Salicylic acid 300 ppm) were sprayed at pre flowering and anthesis stages and their effects were studied on different morpho-physiological and biochemical characters of *Flemingia semialata*. The experiment was conducted in three replications for each treatment and whole experiment was planned under R.B.D design. The different morpho-physiological characters were studied at 15 days interval.

Plant growth study

Among the ten treatments, T_6 (NAA 30 ppm) recorded highest shoot length (102.8), number of branches (6.33), and per cent green leaves per plant (10) where as number of raceme/plant (5.0), floret number/ raceme (127.67), number of pods / raceme (91.44) was recorded highest in T_3 (Thiourea 1000 ppm).

Table 2.2.1 : Effect of plant growth regulators on yield and yield attributes of *F. semialata*

Treatment	No. of raceme / bush	Floret number/ raceme	Peduncle length (cm)	Pod number/ raceme	Seed set (%)	100 Seed weight (g)	Seed yield (g/Plant)
Control	1.33	69.33	15.93	27.00	37.3	2.56	4.9
Thiourea 500 ppm	2.67	94.33	12.70	40.67	66.5	2.67	11.1
Thiourea 1000 ppm	5.00	127.67	9.17	91.44	76.7	2.72	18.4
Thiourea 1500 ppm	3.33	117.33	11.07	60.44	68.9	2.71	15.2
NAA 15 ppm	1.67	79.00	12.77	34.00	63.3	2.74	8.3
NAA 30 ppm	3.67	117.00	10.67	72.62	76.4	2.70	16.4
NAA 45 ppm	2.67	87.67	11.63	38.61	58.2	2.64	10.4
Salicylic Acid 100 ppm	1.67	78.33	13.67	31.61	50.6	2.61	6.5
Salicylic Acid 200 ppm	3.00	103.00	11.53	43.22	70.3	2.64	13.7
Salicylic Acid 300 ppm	1.67	75.33	14.73	32.61	49.1	2.59	6.4
SEm±	0.53	4.62	1.39	0.96	3.15	0.05	0.58
CD (0.05)	1.63	13.47	4.20	2.93	9.42	N/A	1.75

Seed set and pure seed yield

The per cent seed set and pure seed yield (table 2.1) was also improved by the application of different level of PGRs over control. Increase in seed set percent recorded at each lift date (15 days interval) as seen in fig. 2.2.1. Seed set (%) recorded highest in the plant treated with Thiourea 1000 ppm (76.7 %) followed by NAA 30 ppm (76.4 %), salicylic acid 200 ppm (70.3 %), Thiourea 1500 ppm (68.9 %), Thiourea 500 ppm (66.5 %) with respect to control (37.3 %). Further, maximum seed yield (18.4 g/ plant) was recorded in the plants sprayed with Thiourea 1000 ppm followed by NAA 30 ppm (16.4 g/plant) and Thiourea 1500 ppm (15.2 g/plant).

Physiological study

Application of different levels of PGRs maintained higher relative water content of leaves (42.9 - 34.8%), leaf porosity (-31 -14.2 %) and lower water saturation deficit (15.8 - 19.5 %) as compared to control (33.6, -32.7 and 37.4 % respectively). Further, peduncle length in treated plants was recorded lower (9.17- 14.73 cm) than that of control (15.93 cm).

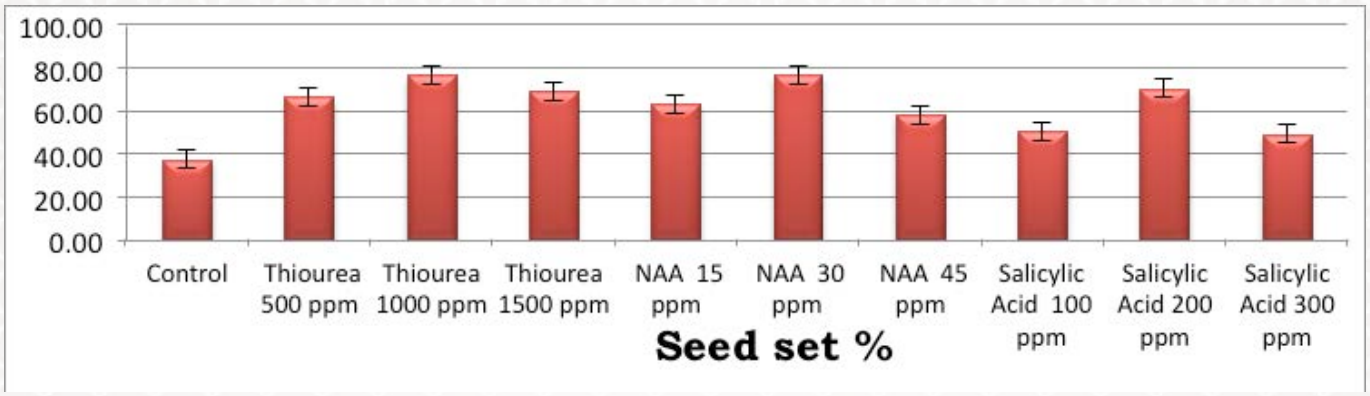


Fig. 2.2.1. Effect of plant growth regulators on seed set percent.

Table 2.2.2: Effect of plant growth regulators on physiological parameters of *F. semialata*

Treatment	Relative leaf water content (%)	Water saturation deficit (%)	Leaf porosity (%)
Control	33.66	37.4	-32.7
Thiourea 500 ppm	37.89	18.1	-24.2
Thiourea 1000 ppm	42.93	16.7	-14.1
Thiourea 1500 ppm	40.53	15.8	-18.9
NAA 15 ppm	35.52	19.5	-1.0
NAA 30 ppm	41.28	17.3	2.6
NAA 45 ppm	36.08	16.9	14.2
Salicylic Acid 100 ppm	34.89	18.4	-4.2
Salicylic Acid 200 ppm	39.78	17.5	-6.4
Salicylic Acid 300 ppm	34.50	17.2	-31.0
SEm±	0.02	0.02	-
CD (0.05)	0.05	3.24	-

Biochemical study

The application of PGRs increased the chlorophyll content and caretenoid and highest values were recorded with Thiourea 1000 ppm (3.05 µg/g fw and 0.48 µg/g fw, respectively) followed by NAA 30 ppm (2.49 µg/g fw and 0.40 µg/g fw, respectively). Lowering the water saturation deficit and increasing the relative water content and leaf porosity (table 2.2.2) due to the application of PGRs resulted higher seed set (49.1-76.7 %) than that of control (37.3 %).

Thus the present study revealed that the application of PGRs improved the seed set and seed yield might be because of high relative water content and leaf porosity, and low water saturation deficit. Among different PGRs and their levels, Thiourea 1000 ppm was found more effective.

2.3 Peoples understanding of agricultural biotechnology in Jharkhand

Agricultural problems of Jharkhand which require biotechnological intervention

Various agricultural problems which required biotech interventions have been identified and listed in table 2.3.1

Relevancy test of knowledge statements for development of knowledge test

In this study, knowledge was conceptualized as the understood information about agricultural biotechnology. For developing knowledge test, 45 statements about agricultural biotechnology were collected from the literature, personal experience and discussion held with experts. These statements were covering different aspects of agricultural biotechnology. These statements were edited and drafted in such a way that each statements highlighted only one idea and did not have any ambiguity. Both positive and negative statements were framed. These statements were provided to thirty judges for relevancy of statements. The judges were requested to check each statement whether the statements were really measuring the knowledge of people about agricultural biotechnology in Jharkhand. They had liberty to add/ delete or modify any of the statements. Response of judges were collected on five point continuum i.e. not relevant, less relevant, relevant, somewhat relevant and most relevant. Scoring of negative statements were reversed. After considering the opinion of judges, 42 statements were retained. Item analysis of these statements would be done.

Table 2.3.1 Agricultural problems of Jharkhand which require agricultural biotechnology intervention

Sl. No.	Agricultural problems	Proposed biotechnology interventions
1.	Acidic soils	Identification of suitable microbes which can improve nutrient availability to the plants, development of suitable crop varieties
2.	Low soil fertility (less organic C, Nitrogen, Phosphorus, Boron, etc.)	Identification of beneficial microbes which may improve mobilization and acquisition of nutrients
3.	Water scarcity	Development of drought tolerant and deep rooted crop varieties
4.	Heavy metal contaminated irrigation water	Phytoremediation
5.	Monocropping	Development of drought tolerant and short duration crop varieties
6.	Post-harvest losses of crops, fruits, vegetables, etc.	Enhancement of shelf life of perishable crops, fruits, vegetables, etc.
7.	Disease and insect pest infestation of crops	Development of disease and insect pest tolerant/ resistant crop varieties.
8.	Less availability of quality fertilizer	Development of nano fertilizers

Relevancy test of attitude statements for development of attitude scale

In this study, attitude was conceptualized as the degree of positive or negative feeling, opinion, belief and action associated with agricultural biotechnology. Attitude scale towards agricultural biotechnology is being developed based on *Likert's technique*. Fifty statements about agricultural biotechnology were gathered from literature, discussion held with experts and personal experience. These statements were edited and framed in such a way that they expressed positive or negative attitude. These statements were provided to thirty judges for relevancy of statements. The judges were requested to check each statement whether the statements were really measuring the attitude of people about agricultural biotechnology in Jharkhand. They had liberty to add/ delete or modify any of the statements. After considering the opinion of judges, 45 statements were retained. Item analysis of these statements would be done.

Available agricultural biotechnology products/ output in Jharkhand

List of few available agricultural biotechnology products/ output in Jharkhand is mentioned below:

Varieties of banana produced through tissue culture

- Graind naine
- Robusta
- Behula

Tissue culture plant is also available following plant species

- Bamboo
- Sugarcane
- Jerbera
- Orchids

Approved On-going Research Projects

List of Approved Research Projects for the Year 2014-15

Sl.	Project Title	Principal Investigator
Fast Track Project		
1.	Construction of cDNA library of Indian lac insect, *Kerria lacca* and screening for genes involved in aleuritic acid biosynthesis.	Mr Anees K.
2.	Small RNA profiling of the Indian lac insect, *Kerria lacca* (Kerr)	Dr Thamilarashi K.
Institute Project		
3.	Zn solubilising rhizobacteria and arbuscularmycorrhizal fungi for biofortification in direct seeded rice	Dr S R Meena
4.	Enhancing pure germinating seed yield of *Flemingia semialata* by physiological approaches.	Dr N K Sinha
5.	Peoples' understanding of agricultural biotechnology in Jharkhand.	Dr V K Yadav

Maintenance of plant species at Garkhatanga campus

Following plant species were maintained in Garkhatanga farm located in the farm A & B of Institute

1. List of Trees in Farm A

Sl. No.	Name of trees	Number
1.	Aonla	363
2.	Mango	138
3.	Guava	371
4.	Litchi	34
5.	Eucalyptus	465
6.	Jackfruit	79
7.	Blackberry	24
8.	Miscellaneous plants (Baken, Sheesham, Siris, Karka, Pojo, Acacia etc.)	91
9.	Bamboo (in boundary)	16

2. List of Trees in Farm B

Sl. No.	Name of trees	Number
1.	Siris	34
2.	Ritha	01
3.	Seesham	139
4.	Teak	137
5.	Gamhar	491
6.	Aonla	55
7.	Chandan	50
8.	Neem	36
9.	Karanj	37
10.	Subabul	56
11.	Sal	89
12.	Khair	12
13.	Arjun	95
14.	Mahuwa	64
15.	Bael	305
16.	Bamboo	287
17.	Misc. Plants (Akashia, Baken, Gamhar, Pojo, Kakra etc.)	125

Publications & Publicity

Publications

Research papers

- Sinha NK, Mertia RS, Santra P and Raja P (2014). Soil seed bank in rangelands of the indian thar desert under different grazing pressures. The Ecoscan, Vol.VI:323-328.
- Sinha NK, Suresh Kumar, Santra P and Raja P and Mertia, Daleep Singh (2014). Temporal growth performance of Indian myrrh (*Commiphora wightii*) raised by seedlings and cuttings from same genetic stocks in the extremely arid Thar desert of India. The Ecoscan, Vol. 8(3&4):241-244.
- Supriya P, Yadav VK, Sindhu AK and Jesudassan V (2014). An e-learning component for agriculture graduates/post graduates. The Indian Journal of Agricultural Sciences, Vol.84 (4): 514-516.
- Yadav VK, Kumar Ashok, Manohar B Dhawad and Supriya P (2014). Training need of tribal farmers regarding seed production, cultivation and value addition in maize. Maize Journal. Vol. 3. (1 & 2): 67-70.

Papers presented / contributed in conference / symposia / seminars

- Lal SK, Kumar Sudhir, Meena SR (2015). Improvement of rice variety for a stem borer resistance through marker assisted selection and marker assisted back crossing. Souvenir and book of abstracts of the National Entomologist Meet, IINRG, Namkum, Ranchi, India, February 5-7, pp.60.
- Meena SR, Kumar Ashok and Yadav VK (2014). Influence of different nutrient management practices on periodical growth and yield behaviour of baby corn, potato and mungbean grown in sequence. Proceedings of the 6th International conference on Bioscience Research for Nutritional Security, Environmental Conservation & Human Health in Rural India (ICBNEHRI-2014), Indian Institute of Natural Resin and Gums, Namkum, Ranchi (India), Dec. 22-24, pp.49-50.
- Meena SR, Kumar Ashok, Jat NK and Yadav VK (2015). Crop quality and nutrient uptake pattern of baby corn under varying nutrient management practices. Compendium-I XII

Agricultural Science Congress, Sustainable Livelihood Security for smallholder Farmers. NDRI, Karnal, February 3-6, pp. 75.

- Meena SR, Lal SK and Tribhuvan KU (2015). Pest management in rice through integrated approaches in Chota Nagpur plateau region. Souvenir and book of abstracts of the National Entomologist Meet, IINRG, Namkum, Ranchi, India, February 5-7, pp.165.
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- Raja P, Srinivas CV, Bhattacharyya BK, Nilendu S, Sinha NK, Singh M, Pandey CB and Bhatt RK (2015). Simulation of land-surface processes using weather research and forecast (wrf) mesoscale atmospheric model over Thar desert, India. Proceedings of the National seminar on Quaternary Stratigraphy, Sedimentation and Sea level Changes, Univ. of Madras, Chennai, pp 22-23.
- Singh M, Sinha NK, Venkatesan and Raja P (2014). Canopy temperature depression and its effect on seed set and seed yield of sewan grass (*Lasiurus sindicus*). Proceedings of the International Symposium on New Dimensions in Agrometeorology for Sustainable Agriculture, G.B. Pant University of Agriculture & Technology, Pantnagar (India), Oct. 16 – 18, pp.,79.
- Sinha NK, Kumawat RN, Raja P and Santra Priyabrata (2014). Response of rainfed crops to colocynth (*Citrullus colocynthis*) intercropping in arid western India. Proceedings of the 6th International conference on Bioscience Research for Nutritional Security, Environmental Conservation & Human Health in Rural India (ICBNEHRI-2014), Indian Institute of Natural Resin and Gums, Namkum, Ranchi (India), Dec. 22-24, pp. 49-50.
- Sinha NK, Ghosh J, Monoborullah Md, Lohot VD, Kumar N (2015). Enhancement of seed production potential of *Flemigia semialata* by using plant growth regulators. Souvenir and book of abstracts of the National Entomologist Meet, IINRG, Namkum, Ranchi, India, February 5-7, pp.43
- Sinha NK, Raja P, Santra P and Singh JP (2014). Livelihood security of marginal farmers of drylands by enhancing khadin productivity. Proceedings of the 7th National Extension Education Congress, ICAR Research Complex for North Eastern Region, Umiam, Megalaya, November 8 - 11, pp. 247.
- Sinha NK, Mertia RS and Santra P (2014). Soil seed bank in rangelands of the Indian Thar desert under different grazing pressures. Proceedings of the National Conference on Harmony With Nature in Context of Environmental Issues & Challenges of the 21st Century, ML Sukhadia University, Udaipur (Rajasthan), November, 28-30, pp. 68.
- Yadav VK, Marwaha S and Singh KP (2014). Maize AGRI-daksh : Expert system and information dissemination of maize. Proceedings of the 7th National Extension Education Congress, ICAR Research Complex for North Eastern Region, Umiam, Megalaya, November 8 - 11, pp. 129-130.
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- Yadav VK and Sinha PK (2014). Socioeconomic impact of baby corn cultivation and value addition. Souvenir & abstract book of 6th International Conference on Bioscience Research for Nutritional Security, Environmental Conservation & Human Health in Rural India, ICAR-Indian Institute of Natural Resins & Gums, Ranchi, December 22-24, pp. 25.

Book/ Chapters/Bulletins/ Manuals/ Project reports

- Tewari JC, Singh JP, Singh Raj, Patel AK, Goyal RK, Santra P, Kumar M., Raja, P., Ratha Krishnan, P, Sinha NK and Roy, MM (2014). Technological Interventions for the Sustainable Management of Drylands in

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- Yadav VK and Supriya P (2014). Value addition in maize. D.P. Chaudhary *et al.* (eds.), Maize: Nutrition Dynamics and Novel Uses. pp. 141-152, DOI 10.1007/978-81-322-1623-0_12, Springer India 2014.
- Yadav VK, Manohar BD and Singh R (2014). Social values and norms. Singh P *et al.* (Ed.). *Extension Education : A Handbook*, Volume I. pp. 353-359. Division of Agricultural Extension, Post Graduate School, IARI, New Delhi- 110 012, ISBN 978-93-83168-12-5.
- Yadav VK, Manohar BD and Singh R (2014). Social change. Singh P *et al.* (Ed.). *Extension Education : A Handbook*, Volume I. pp. 317-322 Division of Agricultural Extension, Post Graduate School, IARI, New Delhi 110 012, ISBN 978-93-83168-12-5.
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- Yadav VK, Dhadwad MB and Singh R (2014). Social process. Singh P *et al.* (Ed.). *Extension Education : A Handbook*, Volume I (pp. 323-328). Division of Agricultural Extension, Post Graduate School, IARI, New Delhi 110 012, ISBN 978-93-83168-12-5.
- Singh R, Yadav VK and Dhadwad MB (2014). Basic concepts in sociology. Singh P *et al.* (Ed.). *Extension Education : A Handbook*, Volume I (pp. 297-307). Division of Agricultural Extension, Post Graduate School, IARI, New Delhi 110 012, ISBN 978-93-83168-12-5.
- Singh R, Yadav VK and Dhadwad MB(2014). Rural sociology. Singh P *et al.* (Ed.). *Extension Education: A Handbook*, Volume I (pp. 308-316). Division of Agricultural Extension, Post Graduate School, IARI, New Delhi 110 012, ISBN 978-93-83168-12-5.
- Singh R and Yadav VK (2014). Theories of Social change. Singh P *et al.* (Ed.). *Extension Education : A Handbook*, Volume I (pp. 329-338). Division of Agricultural Extension, Post Graduate School, IARI, New Delhi 110 012, ISBN 978-93-83168-12-5.

Popular Articles

- Yadav VK, Jat SL and Singh KP (2014). Success storey of baby corn cultivation in Haryana. *Popular Kheti*, Vol. 2, issue-4 (October-December) : pp. 26-28.
- Yadav VK, Jat SL and Singh KP (2014). Aadhik aay ke liye sweet corn ki kheti. *Kisan Kheti*, Vol. 1, issue-4 (October-December): pp.13-15.
- Yadav VK, Kumar A, Kumarawam S, Singh KP (2014). Aadhik aay ke liye baby corn ki kheti. *Krishisewa*, (February 2015).
- Yadav VK (2014). Transferring technology to farmers-DMR shows the way. Indian Farming. Vol.64 (4): pp. 63-67.

Radio/TV talk

Name of Scientist	Topic of TV talk	Date of telecast
Dr VK Yadav	Gain to Maize Technology	02.04.2014
Dr VK Yadav	Maize Technologies	01.04.2014
Dr VK Yadav	Maize Technologies	07.04.2014

Tours/ Visits

- Dr R Ramani visited ICGEB, NIPGR and TERI in Delhi and Gurgaon in connection with development of master plan for IIAB, along with PMC agency on Mar. 25-26, 2014.

Participation of Scientists in Conferences/ Meetings/ Seminars/ Symposia/ Workshops/ Trainings

Papers in Conference/symposia

- Dr R Ramani participated in the meeting of Crop Sci. Div Institutes at Krishi Bhavan

chaired by Sec DARE and DG ICAR and made a presentation of Vision 2050 document of IIAB on Nov 9-10, 2014.

- Dr R Ramani participated in the workshop on Relevance and importance of IPR organized by NRDC and Jharcraft in Ranchi on Nov. 20, 2014.
- Dr Nirmal Kumar, Dr NK Sinha and Dr VK Yadav participated in 7th National Extension Education Congress held at ICAR Research Complex for North Eastern Region, Umiam, Megalaya on November 8-11, 2014.
- Dr NK Sinha and Dr VK Yadav participated National Conference of NEA held at ML Sukhadia University, Udaipur, Rajasthan on November 28-30, 2014.
- Dr Nirmal Kumar, Dr NK Sinha, Dr VK Yadav, Dr SR Meena and Mr SK Lal participated 6th International Conference of ICBNEHRI held at Indian Institute of Natural Resin and Gums, Namkum, Ranchi, Jharkhand on December 22-24, 2014.
- Dr Nirmal Kumar, Dr NK Sinha, Dr VK Yadav, Dr SR Meena and Mr SK Lal participated in National Entomologist Meet of SANRAG held at Indian Institute of Natural Resin and Gums, Namkum, Ranchi, Jharkhand on February 5-7, 2015.
- Dr Nirmal Kumar and Dr VK Yadav participated National Seminar of ISEE held at Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh on February 26-28, 2015.
- Dr Nirmal Kumar attended MDP Workshop on PME of Agricultural Research Projects at NAARM, Hyderabad on 4-8, August, 2014.
- Dr NK Sinha attended Refresher Course on Agriculture Research Management at NAARM, Hyderabad on 14-26 July, 2014.
- Dr. V.K. Yadav attended and presented on Frontline Demonstrations and Training Programme in 57th Annual Maize Workshop held at MPUA&T, Udaipur, Rajsthan from April 21- 23, 2014.
- Dr. V.K. Yadav attended International annual review meeting of ATMA under "Abiotic stress tolerant maize for food and income security among the poor in South and South-East Asia" at ICRISAT, Hyderabad from February 17-18, 2014.

Honour/Awards/recognitions

- Dr NK Sinha, Sr. Sc. received Senior Scientist award by MSET-International Consortium Contemporary Biologist, Ranchi in recognition of progressive research contribution in the field of Seed Technology & Environmental Physiology.
- Dr VK Yadav received Young Scientist Award 2014 conferred by Indian Society of Extension Education, New Delhi for outstanding contribution in the field of Extension Research and Field Education Services, in the ISEE National Seminar- 2014 on "Extension Innovations and Methodologies for Market-Led Agricultural Growth and Development" held at Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during February 26-28, 2015.
- Dr VK Yadav received Best Paper Presentation Award- 2014 conferred by Society of Extension Education, Agra for oral presentation of a paper entitled "Maize AGRIdaksh: Expert System and Information Dissemination of Maize" in 7th National Extension Education Congress held at ICAR Research Complex for NEH Region, Umiam, Meghalaya during November 08-11, 2014.

Distinguished Visitors

Date	Name
04-05/05/2014 & 25/8/2014	Dr S Ayyappan, Secretary, DARE and Director General, ICAR
25/8/2014	Shri Radha Mohan Singh, Hon'ble Union Minister of Agriculture
25/8/2014	Sri Yogendra Saw, State Agriculture Minister, Jharkhand
25/8/2014	Shri Ram Tahal Choudhary, MP, Ranchi
25/8/2014	Shri CP Singh, Former Speaker and MLA, Ranchi
25/8/2014	Dr BP Bhat, Director, ICAR RC ER, Patna
25/8/2014	Dr. R P Singh Ratan, Director (Extn.), BAU, Ranchi

Events

Foundation stone laying ceremony of ICAR- Indian Institute of Agricultural Biotechnology

Hon'ble Union Minister of Agriculture, Shri Radha Mohan Singh, laid the Foundation Stone of Indian Institute of Agricultural Biotechnology (IIAB) on 25th August, 2014 at Garhkhatanga, Ranchi (Jharkhand). Sri Yogendra Saw, State Agriculture Minister, Shri Ram Tahal Choudhary, MP, Ranchi and Shri C.P. Singh, Former Speaker and MLA, elected representatives of local bodies were the special guests. Dr S. Ayyappan, Secretary, DARE and Director General, ICAR, Dr S K Dutta, DDG (CS), Dr A K Singh, ZPD, Zone II, Dr J S Chauhan, ADG (Seed), Directors of local ICAR Institutes, Dr. R P Singh Ratan, Director (Extn.), BAU, Programme Coordinators of KVKs of Jharkhand, officials of Central and State institutions were present during the ceremony. Dr S Ayyappan welcomed the audience and outlined the importance and role of the new Institute in the national agricultural research scenario. After unveiling the foundation stone Hon.MoA addressed a gathering of over 600 which included senior central and state Govt. officials, organizations involved in development of the Institute, representatives of local administrative bodies and farmers. Lauding the ICAR for establishment of the new Institute in an area of about 120 acres with a XII Plan budget of Rs 287.5 crores, he pointed out the importance of biotechnology research for development of resistant varieties especially in view of climate change. He also informed the audience about various central initiatives for agricultural development of the country as well as Jharkhand especially Agricultural Research Institute with a budget of Rs. 500 crores for which land allocation from the State Govt. has been sought. He also informed that Jharkhand would be developed as the agricultural research capital for the eastern region. He dwelled at length on various agricultural development programmes for the country and the high importance to agriculture given by the present Government.

Unveiling of the Foundation stone of IIAB, Ranchi by Hon`able Union Minister of Agriculture

MoA addressing the audience during Foundation stone laying ceremony of IIAB, Ranchi (Smt. Arti Kujur, Smt. Sundari Tirkey, Shri C.P. Singh, ShriYogendra Saw, Shri R.T. Chaudhary, Dr. S. Ayyappan, Dr. S.K. Dutta, Dr. R. Ramani from left to right)

Hon`able Union Minister of Agriculture addressing the audience during Foundation stone laying ceremony of IIAB, Ranchi

Important Committees

Institute Management Committee

1	Dr R Ramani, OSD, IIAB (upto June 10, 2015)	Chairman
2	Dr JS Chauhan, ADG (Seed), ICAR, New Delhi	Member
3	Dr Shivendra Kumar, Ex- Head, ICAR RCER, Ranchi	Member
4	Dr (Ms.) Poonam Sikka, PS, CIR on Buffalo, Hisar	Member
5	Dr SR Bhat, PS, NRCPB, New Delhi	Member
6	Sri Sujeet Kumar Singh, Sr. AO, IINRG, Ranchi	Member Secretary

Research Advisory Committee

1	Dr. C.D. Mayee, Former Chairman, ASRB	Chairman
2	Dr. Swapan Kumar Datta. DDG (CS), ICAR. New Delhi	Member
3	Prof. A.N. Lahiri Majumder. Raja Ramanna Fellow (DAE), Division of Plant Biology. Bose Institute Kolkata	Member
4	Prof. P. Balasubramanian, CPMB, TNAU, Coimbatore	Member
5	Dr. N.K. Singh, National Professor, NRCPB, New Delhi	Member
6	Dr. R. Ramani, Director, IINRC and OSD. IIAB. Ranchi	Member
7	Dr. Nirmal Kumar, PS, IIAB. Ranchi	Member Secretary

Institute Research Committee

The Institute Research Committee (IRC) meeting for the year 2014-15 was held on 1st August, 2014 and 8th December, 2014 under the Chairmanship of Dr R. Ramani, Director, IINRG & OSD, IIAB in the Conference Hall of IINRG to review the progress of Institutional research project and Fast track project. In his opening remark, R. Ramani, Chairman IRC welcomed the scientist present in the meeting. Chairman, IRC informed that the meeting has called for review the progress of the on-going Institutional & Fast track research project and new research project proposal and finalization of for research projects for 2015-16. He opined that Scientists have to give careful consideration to RAC recommendations before proposing new projects.

Sports Committee

- Dr Nirmal Kumar, Dr NK Sinha and Mr SK Lal participated in ICAR Zonal Sports Meets for Eastern Zone -2014 held held at CRIJAF, Barrackpore during 14-17 October, 2014.

Extension Activities

ICAR-Indian Institute of Agricultural Biotechnology (IIAB) organized Farmers' awareness cum training programme on "Importance and uses of Agricultural Biotechnology" in Tetri Dahutoli village of Namkum Block of Ranchi (Jharkhand) on 30th March, 2015. One hundred one farmers (including farm women, youth and tribal farmers) participated in the programme. Villagers were very happy because this kind of programme was organized first time in this village. Villagers were not at all aware of recent developments in agriculture and allied sectors. They expressed need of soil testing of their land, organizing training programme in the village before *Kharif* season and farmers' visit to ICAR institutes and nearby State Agriculture Universities. Programme ended with vote of thanks by Dr. S.R. Meena, Scientist, IIAB to the chair and participants.

Budget

Budget Allocation and utilization during 2014-15. (Rupees in lakhs)

Name of the Head	Non Plan		Plan	
	R.E. 2014-15	Prog. Exp March 2015	R.E. 2014-15	Prog. Exp March 2015
GRANT IN AID CAPITAL				
Works				
(A) Land	0.00	0.00	0.00	0.00
(B) Building	0.00	0.00	0.00	0.00
i. Office Building	0.00	0.00	249.83	249.82
ii. Residential Building	0.00	0.00	0.00	0.00
iii. Minor Works	0.00	0.00	0.00	0.00
Equipments	0.00	0.00	0.00	0.00
Information Technology	0.00	0.00	4.50	4.50
Library Books & Journals	0.00	0.00	0.00	0.00
Vehicle & Vessels	0.00	0.00	0.00	0.00
Live Stock	0.00	0.00	0.00	0.00
Furniture & Fixtures	0.00	0.00	4.00	3.92
Others	0.00	0.00	0.00	0.00
Total Capital Expenditures	0.00	0.00	258.33	258.23
GRANT IN AID SALARIES (REVENUE)				
Establishment Expenses (Salaries)				
i. Establishment charges	75.00	57.48	0.00	0.00
ii. Wages	0.00	0.00	0.00	0.00
iii. Over Time Allowance	0.00	0.00	0.00	0.00
Total Estt. expenses (grant in Aid-Salaries)	75.00	57.48	0.00	0.00
GRANT IN AID GENERAL (REVENUE)				
Pension & Other Retirement Benefits	0.00	0.00	0.00	0.00
Travelling Allowances				
(A) Domestic TA/ Transfer TA	0.00	0.00	5.28	5.25
(B) Foreign TA	0.00	0.00	0.00	0.00
Research & Operational Expenses				
(A) Research Expenses	0.00	0.00	0.00	0.00
(B) Operational Expenses	0.00	0.00	5.00	5.00
Administrative Expenses				
(A) Infrastructure	0.00	0.00	13.00	12.71
(B) Communication	0.00	0.00	0.00	0.00
(C) Repairs & Maintenance				
i. Equipment, Vehicle & Others	0.00	0.00	0.00	0.00
ii. Office Building	0.00	0.00	0.00	0.00
iii. Residential Building	0.00	0.00	0.00	0.00
iv. Minor Works	0.00	0.00	0.00	0.00
(D) Others Admin. Expenses	0.00	0.00	10.86	10.58
Miscellaneous Expenses				
(A) HRD	0.00	0.00	0.46	0.45
(B) Other Items (Fellowship/ Scholarship etc.)	0.00	0.00	0.00	0.00
(C) Publicity & Exhibitions	0.00	0.00	0.00	0.00
(D) Guest House Maintenance	0.00	0.00	0.00	0.00
(E) Other Miscellaneous	0.00	0.00	1.40	1.32
Total Grant in Aid- General	**0.00**	**0.00**	**36.00**	**35.31**
Total Rev (Grant in aid gen. + grant in aid salaries)	**75.00**	**57.48**	**36.00**	**35.31**
GRAND TOTAL (Capital + Revenue)	**75.00**	**57.48**	**294.33**	**293.54**
Loans & Advances	0.00	0.00	0.00	0.00

Personnel

The following personnel have been appointed/transfer to the Institute

Name		Post held	Specialization	Joining date in IIAB
Dr. T R Sharma *Director* National Research Centre on Plant Biotechnology, Pusa Campus, New Delhi		OSD, IIAB	Plant Biotechnology	11/06/2015 till date
Dr R Ramani *Director* Indian Institute of Natural Resins & Gums (IINRG),Ranchi		OSD, IIAB	Entomology	10/10/2012 to 10/06/2015
Dr Nirmal Kumar		Principal Scientist	Agricultural Extension	10/06/2013
Dr N K Sinha		Senior Scientist	Seed Technology	09/12/2013
Dr V K Yadav		Senior Scientist	Agricultural Extension	25/06/2014
Dr Seeta Ram Meena		Scientist	Agronomy	21/04/2014
Mr Shambhu KrishanLal		Scientist	Agricultural Biotechnology	09/04/2014

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch

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