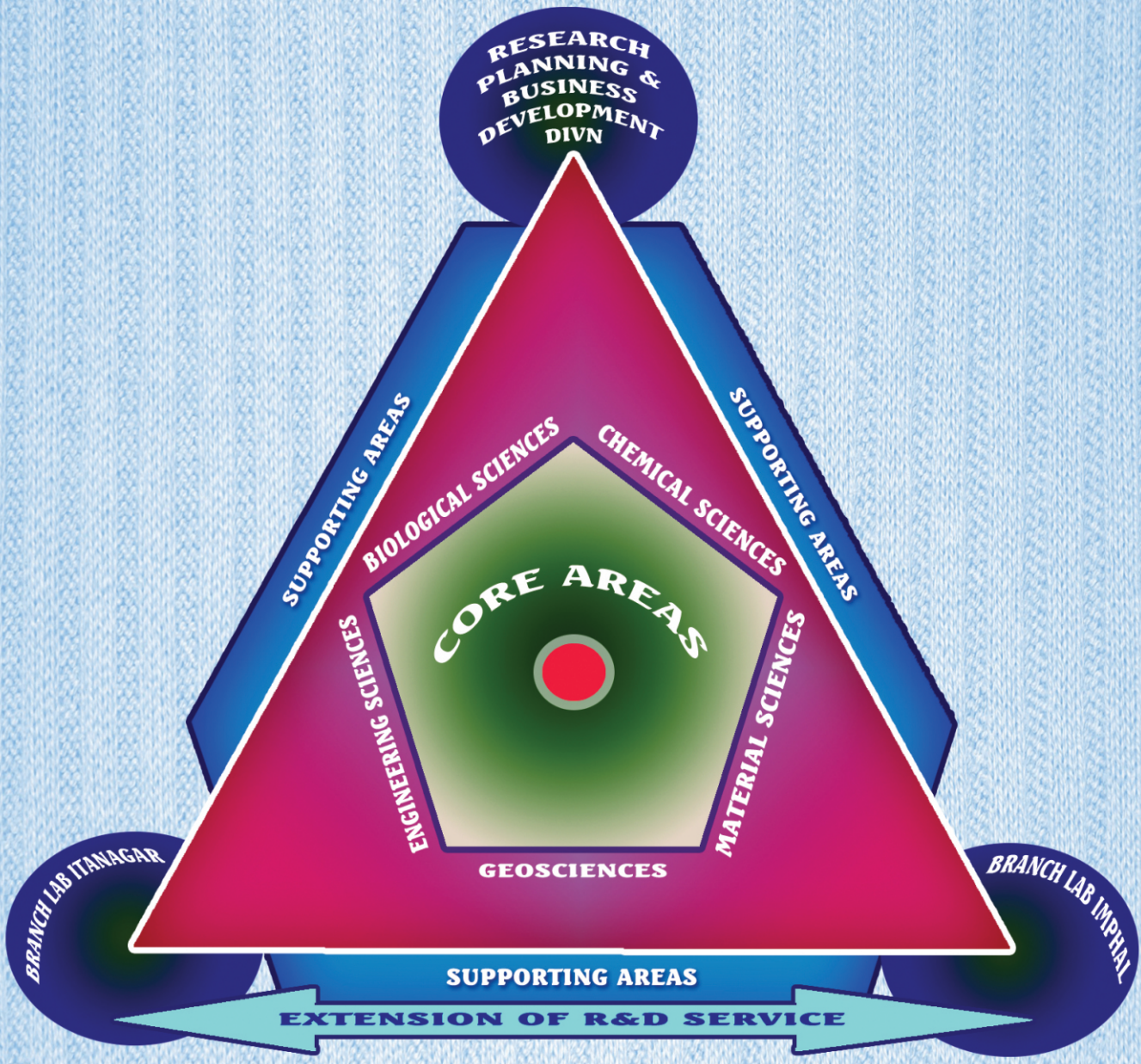
वार्षिक प्रतिवेदन
ANNUAL REPORT
2015-2016



सीएसआईआर-उत्तर पूर्व विज्ञान तथा प्रौद्योगिकी संस्थान, जोरहाट
CSIR-NORTH EAST INSTITUTE OF SCIENCE & TECHNOLOGY, JORHAT



QUALITY POLICY OF CSIR-NEIST

CSIR-North East Institute of Science & Technology, Jorhat is committed to achieve excellence with quality outputs in R&D in frontier areas, professional consultancy and contract services in Chemical, Biology and Allied Sciences to be offered to customers in public and private domains at national and international levels.

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About CSIR-NEIST, Jorhat



CSIR-NEIST, Jorhat (Assam) was established in the year 1961 as one of the multidisciplinary CSIR laboratories. The constituent laboratories of CSIR are grouped into five broad areas such as Physical Sciences, Chemical Sciences, Biological Sciences, Engineering Sciences and Information Sciences depending upon the type of work, objective and the nature of responsibilities vested on these laboratories. On this basis, CSIR-NEIST is one among the seven laboratories under the Chemical Science group. The major thrust of R&D activities of CSIR-NEIST, Jorhat has been to develop indigenous technologies and knowledge base by utilizing the immense natural wealth of the North Eastern region of India. The North Eastern region of the country being bestowed with an abundance of material resources like petroleum, natural gas, minerals, tea and aromatic & medicinal plants and hence the laboratory was assigned to undertake research for development of expertise and know-how for a wide range of industries and extension works. Over the years, the Institute has generated number of technologies/services in the areas of Biological Sciences, Chemical Sciences, Engineering Sciences, Material Sciences and Geosciences of which a large number, specially Micro, Small and Medium (MSM) technologies were commercial successes culminating in setting up of various industries throughout the country. The Institute also developed expertise in the areas like natural products chemistry, drugs and drug intermediates, VSK cement technology, agro-technologies, petrochemicals, crude-oil transportations, paper and paper products, beneficiation chemicals, ecology and environment studies, geotechnical investigations, foundation design engineering, soil investigation and building materials including testing & analysis. On the basis of the technologies developed, CSIR-NEIST bagged CSIR-Technology Award continuously for four years from 2010 to 2013, besides several awards received by the scientists of the Institute.

The Institute is committed to focus and design its activities at different point of time in accordance with the national commitments and priorities. The Institute also has tie-up with other research and academic institutions for functional and other coordinations for HRD and S&T developments of the region in particular and the country as a whole. Efforts have also been made to further evolve the Institute as a leading S&T player in the present global scenario.

From the Director's Desk



It gives me immense pleasure to present before you the Annual Report of CSIR-North East Institute of Science & Technology for the year 2015-16. The Institute has made significant progress during the year in many fronts. The year 2015-16 has been equally challenging and eventful as the Institute experienced a major transition phase. I thank all my colleagues and staff members for working together as a team and accomplishing the tasks that came in hand.

During the year, a technology on, ''Process for Bioremediation of Contaminated Soil' was transferred for commercialization to a party, while the technology on 'Liquid Deodorant & Cleaner' transferred in early 2015 started commercial production. I am also delighted to share that further, the Institute developed a new technology on 'Dispersible Solid Deodorant & Cleaner'. On the publication side, the Institute published a total of 114 papers in reputed journals with an average impact factor of 3.312 which is a significant improvement over the previous year. On the IPR front, 11 Patents were granted in India & Abroad, while 10 patents were filed in India & Abroad.

This year, the Institute was honoured by the visit of Shri Y S Chowdary, Hon'ble Minister of State for Science & Technology and Earth Sciences, Govt. of India during 25-26 January, 2016, which has been a truly encouraging experience for us. The Institute also hosted the Materials Research Society of India (MRSI) Symposium on 'Advanced Materials for Sustainable Applications' and 27th Annual General Meeting of MRSI during 18-21 February, 2016, jointly with Tezpur University and IIT, Guwahati.

The Institute continued to render its services to the people of the region through various programs and activities. On the societal front, the Institute along with its branch laboratories in Imphal (Manipur) and Itanagar (Arunachal Pradesh) imparted training and demonstration of its low cost technologies like Mushroom cultivation, Vermicompost cultivation and cultivation of Medicinal & Aromatic Plants to the

rural masses to provide them avenues for earning livelihood. The programs under human resource development have been significant with an increased no. of students, who enrolled for Ph D programs under AcSIR and other universities of the region and outside.

I would also like to inform that during the period, some of our staff members have received prestigious awards in recognition of their contribution, viz., Índian Institute of Mineral Engineering Award 2015' awarded to Dr B K Saikia, Scientist, 'Vical Award' to Dr Swapnali Hazarika, Sr Scientist and Ms. Indumoni Das, Research Fellow and the 'State Science Communicator Award 2016' by Govt. of Manipur to Dr H B Singh, Pr Scientist & Scientist-in-charge, CSIR-NEIST branch lab., Imphal.

We have also reorganized our R&D divisions into five, namely, Biological Sciences & Technology Division, Chemical Sciences & Technology Division, Engineering Sciences & Technology Division, Geo Sciences & Technology Division and Materials Science & Technology Division. We have also made significant progress in infrastructure development, with some projects continuing and likely to be completed in the next year.

I sincerely acknowledge the guidance and encouragement received from our Research Council and Management Council and also thank once again each and every member of the Institute for their sincere contributions, hard work and dedication in the overall achievements and progress of the Institute.

09 May, 2016

(D Ramaiah)
Director, CSIR-NEIST

निदेशक के डेस्क से



सीएसआईआर-उत्तर पूर्व विज्ञान तथा प्रोद्योगिकी संस्थान, जोरहाट वर्ष 2015-16 की वार्षिक रिपोर्ट आपके समक्ष प्रस्तुत करते हुए मुझे हर्ष हो रहा है। संस्थान कई मोर्चों पर वर्ष के दौरान महत्वपूर्ण प्रगति की है।वर्ष 2015-16 के दौरान संस्थान की गतिविधियां समान रूप से चुनौतीपूर्ण और घटनापूर्ण रहने के साथ-साथ एक प्रमुख संक्रमण चरण का अनुभव किया। मैं एक टीम के रूप में एक साथ काम कर रहे सभी सहकर्मियों को धन्यवाद देता हूँ जिन्होनें अपने हाथ में आए कार्य एवं ज़िम्मेदारी को दक्षता के साथ पूरा किया।

वर्ष के दौरान, 'दूषित मिट्टी के जैविक उपचार के लिए प्रक्रिया' नामक प्रौद्योगिकी एक उद्यमी को व्यावसायीकरण के लिए स्थानांतरित किया गया, जबकि 2015 के आरंभ में स्थानांतरित किया गया 'लिक्विड दुर्गन्धहारी व क्लीनर' नामक प्रोद्योगिकी का वाणिज्यिक उत्पादन शुरू हो गया है। मैं इस खुशी को भी आपसे साझा करना चाहता हूँ कि संस्थान ने 'विसर्जन ठोस दुर्गन्धहारी व क्लीनर' पर एक नई तकनीक विकसित की है। प्रकाशन के क्षेत्र में, संस्थान ने औसत 3.312 इंपेक्ट फ़ैक्टर के अनुसंधान पत्रिकाओं में कुल 114 अनुसंधान पत्र प्रकाशित किया जो पिछले वर्ष की तुलना में एक महत्वपूर्ण वृद्धि है। बौद्धिक संपदा अधिकार के मोर्चे पर, 11 पेटेंट भारत और विदेश में ग्रांट की गई, जबकि 10 पेटेंट भारत और विदेश में फाइल किए गए।

इस वर्ष 25-26 जनवरी 2016 को माननीय श्री वाई एस चौधरी, राज्य मंत्री, भारत सरकार, विज्ञान एवं प्रौद्योगिकी एवं पृथ्वी विज्ञान मंत्रालय का संस्थान में आगमन हुआ, जो हमारे लिए वास्तव में एक उत्साहजनक अनुभव रहा और हम सम्मानित हुए ।संस्थान ने 18-21 फरवरी, 2016 के दौरान तेजपुर विश्वविद्यालय और आईआईटी, गुवाहाटी के संयुक्त तत्वावधन एमआरएसआई की 27वीं वार्षिक आम बैठक एवं 'सतत अनुप्रयोगों के लिए उन्नत सामग्री' विषय पर संगोष्ठी आयोजन कर सामग्री अनुसंधान सोसायटी (एमआरएसआई) भारत की मेजबानी की।

संस्थान के विभिन्न कार्यक्रमों और गतिविधियों के माध्यम से क्षेत्र के लोगों को अपनी सेवाएं प्रस्तुत करने के लिए सतत प्रयत्नशील है और अनुसंधान जारी है। सामाजिक मोर्चे पर संस्थान इम्फाल (मणिपुर) और ईटानगर (अरूणाचल प्रदेश) में अपनी शाखा प्रयोगशालाओं के साथ-साथ ग्रामीण जनता के लिए प्रशिक्षण और मशरूम की खेती, वर्मीकम्पोस्ट की खेती और औषधीय और सुगंधित पौधों की खेती जैसी कम लागत की प्रौद्योगिकियों को प्रदर्शित एवं प्रदान किया है, उन्हें आजीविका कमाने के लिए सुंदर अवसर प्रदान किया है। मानव संसाधन विकास कार्यक्रमों के तहत हमारे एसीएसआईआर एवं अन्य विश्वविद्यालयों के अंतर्गत काफी संख्या में पीएचडी के लिए छात्रों का यहाँ नामांकन हुआ है।

मैं यह भी सूचित करना चाहता हूँ कि इस अवधि के दौरान हमारे स्टाफ के कुछ सदस्यों ने अपने उपयोगी योगदान के कारण सम्मान एवं प्रतिष्ठित पुरस्कार प्राप्त किया है अर्थात 'इंडियन इंस्टीट्यूट ऑफ मिनरल इंजीनियरिंग पुरस्कार २०१५' पुरस्कार से हमारे वैज्ञानिक के भारतीय डॉ बीके सैकिया को सम्मानित किया गया। प्रतिष्ठित "वाइकल पुरस्कार " हमारे वरिष्ठ वैज्ञानिक, डॉ स्वपनाली हजारिका एवं सुश्री इंदुमोनी दास, रिसर्च फैलो को प्राप्त हुआ। मणिपुर राज्य सरकार द्वारा 'राज्य विज्ञान संचार अवार्ड २०१६' हमारे प्रमुख वैज्ञानिक एवं वैज्ञानिक प्रभारी, सीएसआईआर-निस्ट शाखा प्रयोगशाला, इम्फाल मणिपुर डॉ एचबी सिंह को मिला।

हमने संस्थान के अनुसंधान एवं विकास विभाग को पुनर्गठित कर पांच प्रभागों में वर्गीकृत किया है - इनके नाम हैं, जैविकी विज्ञान एवं प्रौद्योगिकी प्रभाग, रसायनिकी विज्ञान एवं प्रौद्योगिकी प्रभाग, इंजीनियरिंग विज्ञान और प्रौद्योगिकी प्रभाग, भू विज्ञान एवं प्रौद्योगिकी प्रभाग और सामग्री विज्ञान एवं प्रौद्योगिकी प्रभाग। हमने बुनियादी ढांचे के विकास में महत्वपूर्ण प्रगति की है जबकि कुछ परियोजनाओं के कार्य जारी हैं और कुछ अगले वर्ष में पूरा होने की संभावना है।

मैं अनुसंधान परिषद और प्रबंधन परिषद का शुक्रिया अदा करता हूँ जिनके मार्गदर्शन एवं प्रोत्साहन लगातार प्राप्त होते रहे और साथ ही संस्थान के समग्र उपलब्धियों में अमूल्य योगदान, कड़ी मेहनत और समर्पण भाव के लिए प्रत्येक सदस्यों को धन्यवाद देता हूँ।

09 मई, 2016

(डी रामाय्या)
निदेशक, सीएसआईआर-निस्ट

CSIR-NEIST AT A GLANCE
2015-2016

RESOURCE BASE

Infrastructural	
R&D Groups	13
Branch Laboratory	02
Seismic Stations	27

HUMAN RESOURCES

Total S&T Staff	**338**
Scientist (Gr IV)	69
Technical (Gr III)	64
Technical (Gr I+Gr II)	115
Total Administrative Staff	**90**

FINANCIAL

	(Rs in Lakhs)
Government Allocation	6769.79
From Contract R&D and Consultancy	727.56
Testing/ Analytical Services	17.23
Miscellaneous including Royalty/ Premia	2.182

BUDGET

	Sanctioned (Rs in Lakhs)
Recurring	3860.828
Capital	1642.100
Network Project (task force)	
Capital	190.300
Recurring	1076.567

R&D PERFORMANCE: 2015-2016

Knowledge Generation

Papers published	**114**
International peer reviewed Journals	96
National peer reviewed Journals	05
Book Chapters	11
Proceedings	02
Average IF	**3.312**
Highest IF (Review)	**8.471**
Highest IF (Research)	**14.018**

Technological Output

Process developed	01
Processes released to industry	01

Extramural & Human Resource Development

PI, DST Woman Scientist Scheme	01
Research Associates, CSIR	01
Research Associates, DBT	01
Sr Research Fellow	19
Jr Research Fellow	12
CSIR-TWAS Fellow	04
DST Inspire Faculty	01
Young Scientist Scheme	03
TWAS-ROCASA	01
DBT Ramalingaswami Re-entry fellow	01
DST Ramanujan fellow	01
Project Fellow	156

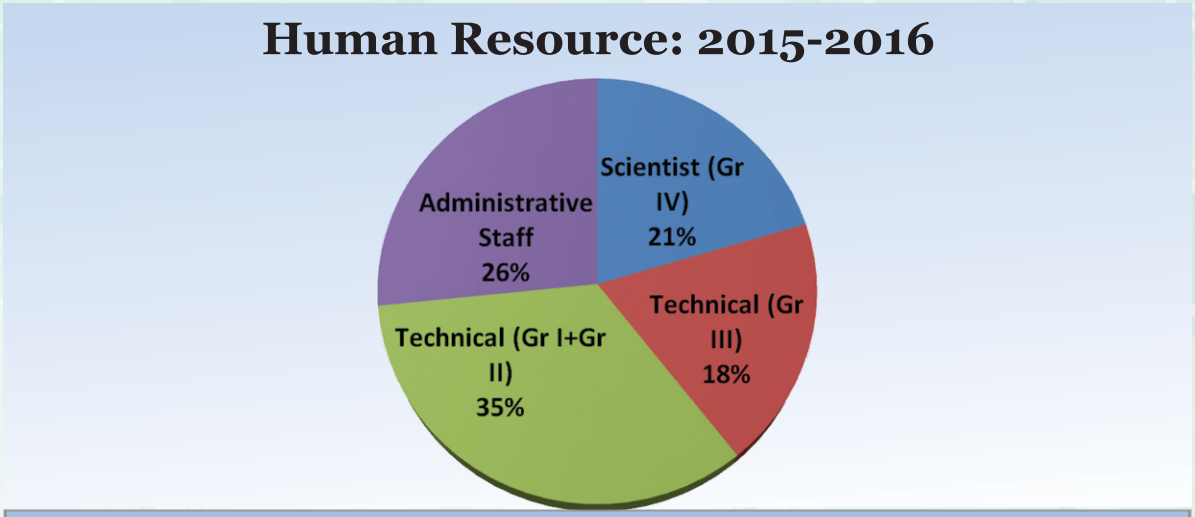
Patents Filed

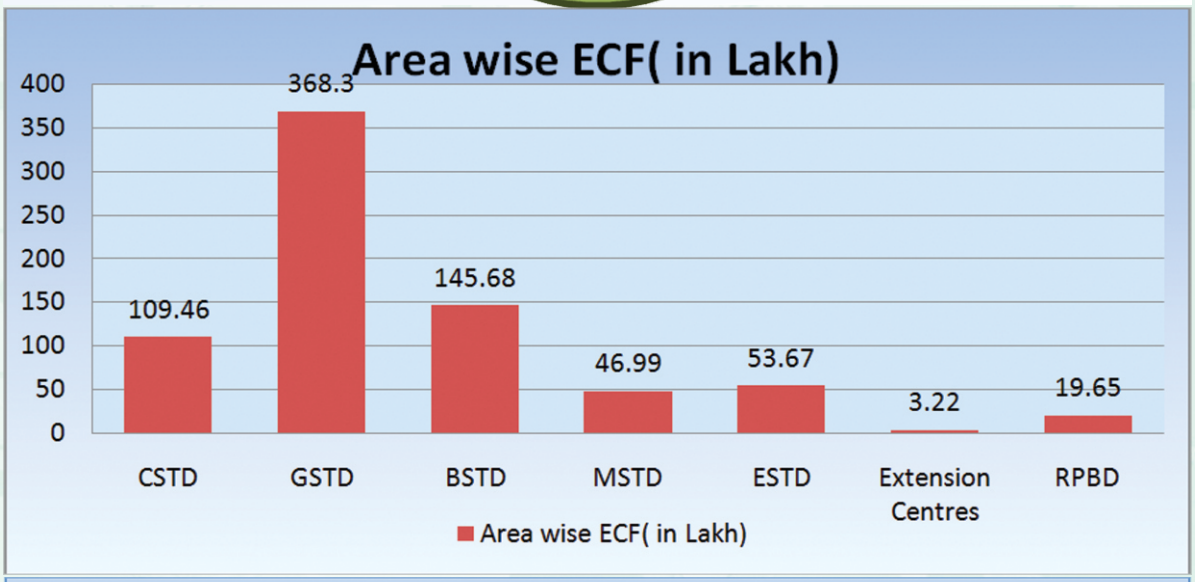
In India	03
Abroad	07

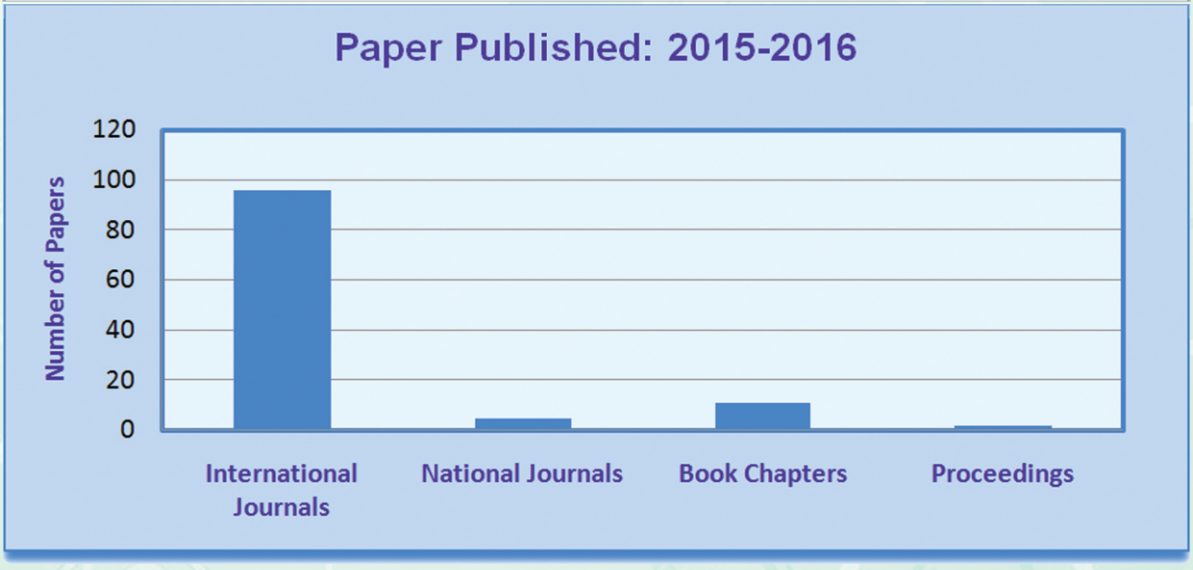
Patents Granted

In India	05
Abroad	06

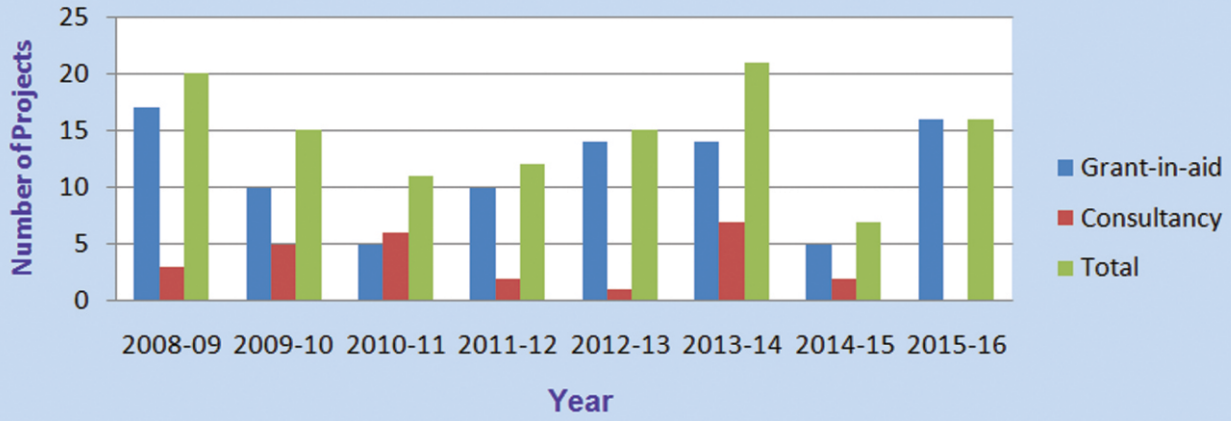
PERFORMANCE INDICATOR



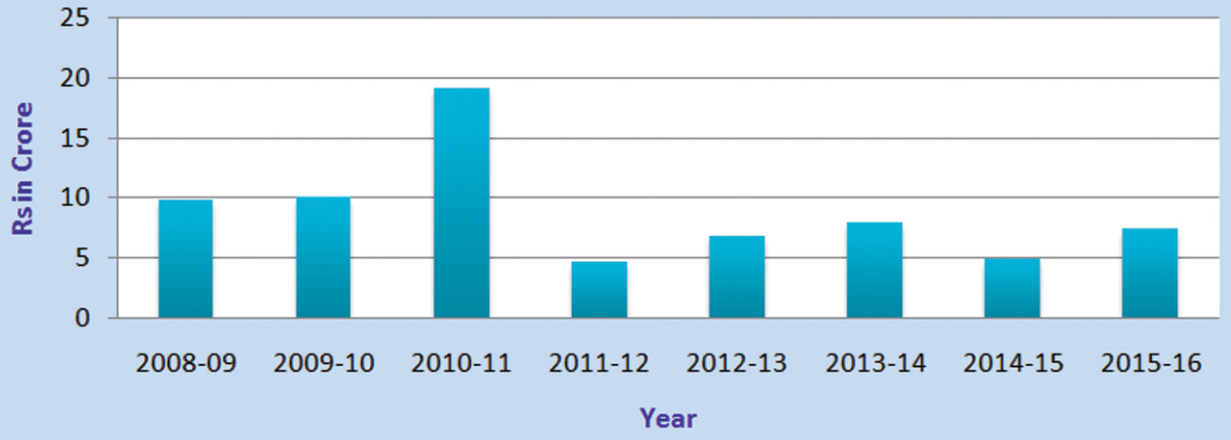




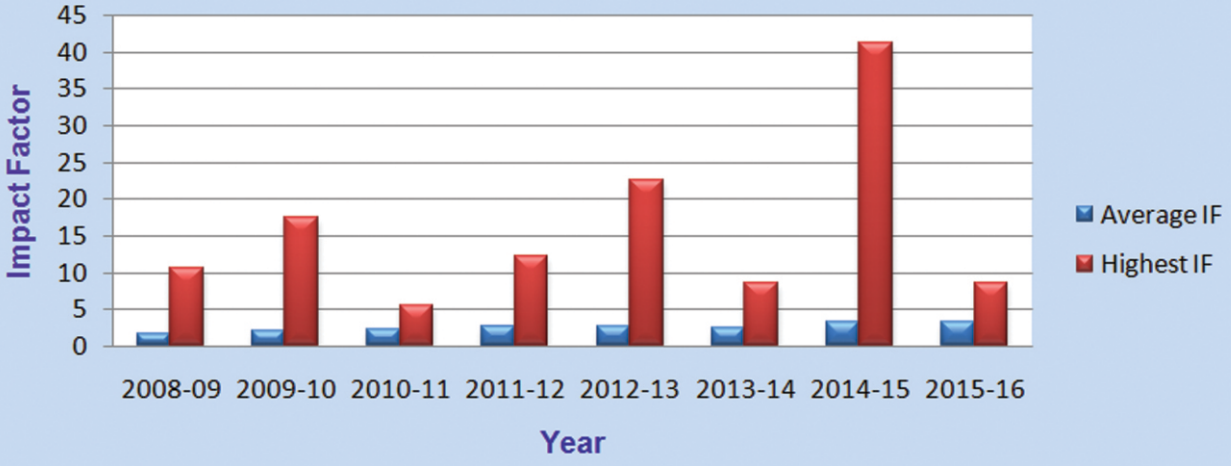
Funded Projects Completed



External Cash Flow



Impact Factor



MEMBERS OF RESEARCH COUNCIL

2015-2016



Prof Harsh K Gupta,
Member, NDMA, New Delhi
Chairman



Prof H R Wason, Emeritus
Fellow, IIT, Roorkee
External Member



Prof Samir Bhattacharyya,
Former Director,
CSIR-IICB, Kolkata
External Member



Prof BB Dhar,
Former Director,
CSIR-CIMFR
External Member



Shri Ashoke Kumar Dutta,
North East Council
Member



K. C. Gupta, Former Director
Indian Institute of Toxicology
Research (IITR), Lucknow
Sister Laboratory

Head or his nominee, PPD,
CSIR, New Delhi



Prof B K Konwar, V C
Nagaland University, Lumami
External Member



Prof Kankan Bhattacharyya,
IACS, Kolkata
External Member



Prof K S Rangappa,
V C, University of Mysore,
External Member



Dr P K Biswas, Former
Advisor (S & T), Planning
Commission
External Member



Dr A Ajayghosh, Outstanding
Scientist, CSIR –NIIST
Thiruvanathapuram
DG's Nominee



Dr. Suresh Das, Director
CSIR –NIIST
Thiruvanathapuram
Cluster Director



Dr D Ramaiah, Director,
CSIR-NEIST, Jorhat
Director

Permanent Invitee

MEMBERS OF MANAGEMENT COUNCIL

2015-2016



Dr D Ramaiah, Director,
CSIR-NEIST, Jorhat
Chairman



Dr Dipak Prajapati,
Chief Scientist, CSIR-NEIST
Member



Dr Tridip Goswami,
Principal Scientist,
CSIR-NEIST
Member



DR (Mrs) A M Das,
Scientist, CSIR-NEIST
Member



Shri Parag Patar
Finance and Accounts Officer
CSIR-NEIST
Member



Dr M Lakshmikantam
CSIR-Indian Institute of
Chemical Technology,
Hyderabad
Member



Dr R L Bezbaruah, Senior
Principal Scientist,
CSIR-NEIST
Member



Dr Mantu Bhuyan,
Scientist, CSIR-NEIST
Member



Shri O P Sahu,
Principal Technical Officer
CSIR-NEIST
Member

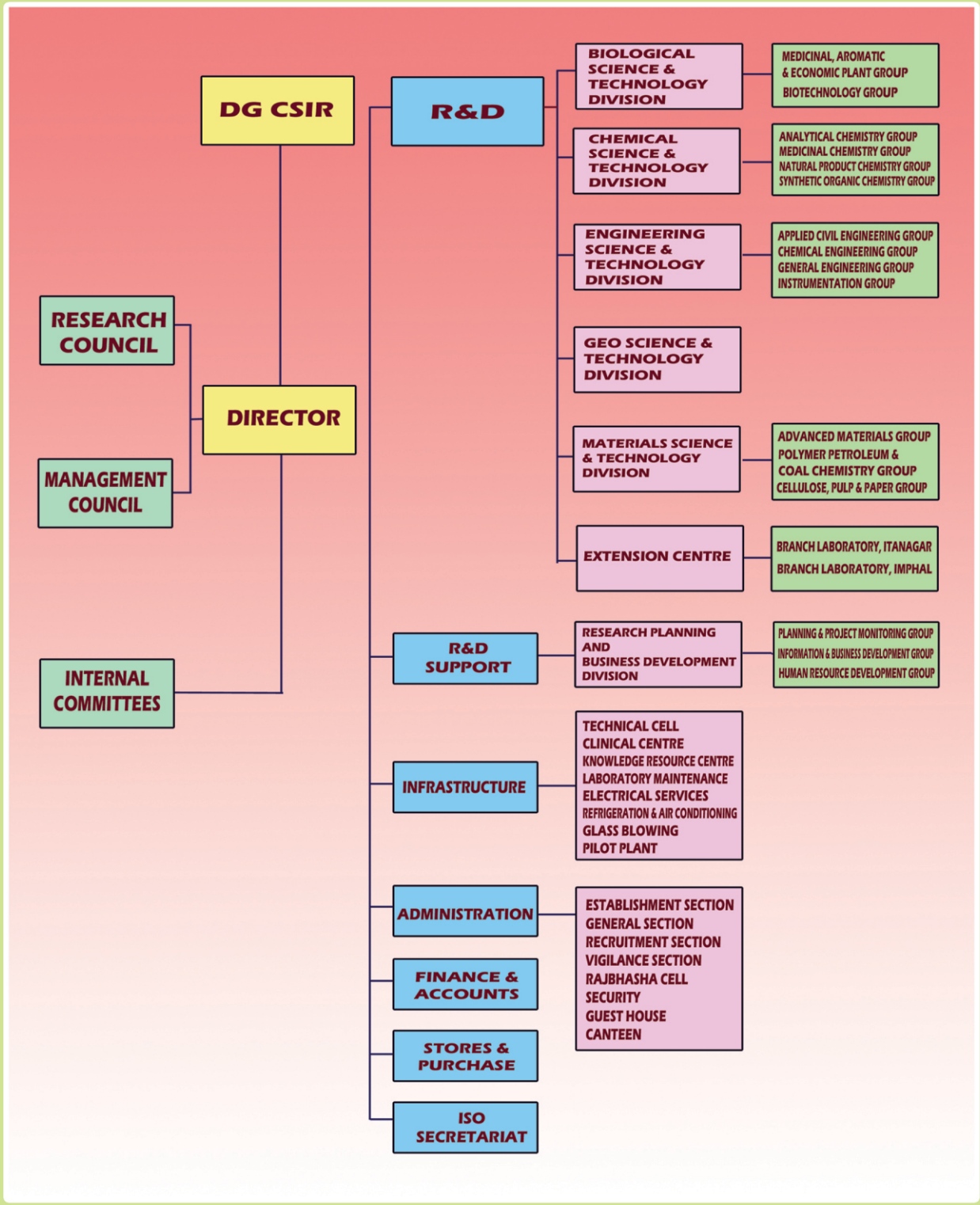


Dr R C Boruah,
Outstanding Scientist,
CSIR-NEIST
Special Invitee



Shri Vikram Singh,
Administrative Officer
CSIR-NEIST
Member - Secretary

ORGANIZATION CHART



R & D ACTIVITIES

BIOLOGICAL SCIENCES & TECHNOLOGY DIVISION

As one of the major areas in R&D, Biological Sciences & Technology Division carried out few major projects on exploration of the plant resources, identification of potential medicinal, aromatic and industrial value up to development of process, technology and conservation of plants of NE India. The main objective of the division is development of technology for mass multiplication of commercially viable species and their conservation with value addition of the germplasm through development of different products and dissemination of proven technologies to the people, Govt. Organizations, entrepreneurs for overall economic development. The Division is also engaged in bio-prospecting and bio-profiling microbial diversity from North East (NE) Gene pool. More than 2000 microbial strains were isolated, maintained and utilized from specific niches of this biodiversity hot-spot. The group is supplementing novel bacterial genus and species into world microbial taxonomy from NE gene pool in collaboration with IMTECH, Chandigarh. The division has developed efficient bacterial consortia as a part of bioremediation package which were extensively applied in ONGC oil fields with success. In the last few years selected PGPR strains have been used in bio-formulation packages and the technology has been released and successfully commissioned. Whole genome sequencing of certain hydrocarbon degrading and antibiotic producing microbial strains and their analysis has been completed to understand their potentialities in molecular level. Bio control potentialities of certain short-listed strains have been evaluated for their field applications. Extensive study on silk worm biochemistry and productivity has resulted in developing technology packages. DBT-sponsored Bioinformatics facility is catering to the needs of both scientists and students immensely.

A) National Collaboration

(i) Network Projects

Project Title: New initiative to boost Agriculture Productivity through maximizing pre- and post- harvest yields.

Project No: BSC-105

Funding Agency: CSIR, New Delhi

Nodal Laboratory: CSIR-CFTRI, Mysore

Participating Laboratories : CSIR – NEIST, Jorhat

PI & Members: Dr Jatin Kalita (PI), Dr M Bhuyan, Mr Tobiul Hussain

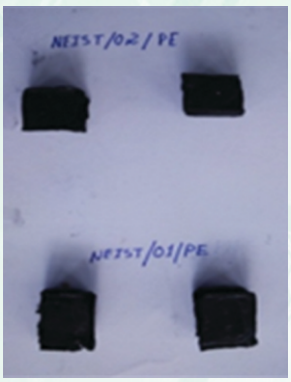
Objective (CSIR-NEIST):

- Development of Plant based Formulations for control of Insect-pest of stored pulses & cereals.
- Development of Economically & Environmentally sustainable strategies for the conversion of cereal & fruit processing by-products into new foods with ambitious market opportunities.
- Development of protocols for high value molecules for preparation of Nutraceuticals & Functional foods having antioxidant, anti-inflammatory and other organoleptic properties.

Salient Achievements:

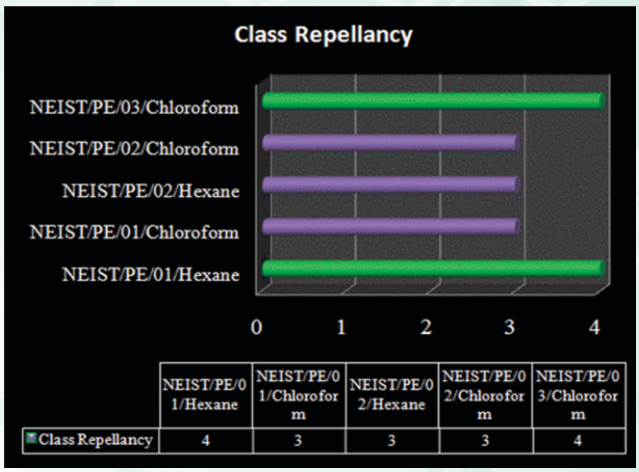
Stored Grain insect pest cause tremendous damage to grains quantitatively & qualitatively. As per reports, the average damage caused by the stored grain insect

pest 15% and extends up to 30% causing great economic loss for a developing country like India. Available chemical pesticides although effective to control the pest, but exhibits significant health hazards and there is an urgent need to develop a formulation without having side health hazards. Development of a novel herbal fumigant formulation with micro-encapsulated bioactive herbal products with significant repellent properties against stored grain insect pest is in progress which is still in laboratory scale and need to develop in pilot scale for commercialization.





Herbal fumigant formulation for control of stored grain insect pest



	NEIST/PE/01/Hexane	NEIST/PE/01/Chloroform	NEIST/PE/02/Hexane	NEIST/PE/02/Chloroform	NEIST/PE/03/Chloroform
Class Repellancy	4	3	3	3	4

Project Title: Bio prospection of Plant Resources and Other Natural Products.

Project No: BSC-106

Funding Agency: CSIR

PI & Members: Dr BS Bhau (PI), Dr D Banik , Dr Mohan Lal

Salient Achievements:

The resource survey activities of Gibbon Wildlife Sanctuary, Jorhat, Assam and Nokrek Biosphere Reserve, Garo hills, Meghalaya along with review of literature resulted in compilation of ethnomedicinal information of nearly 240 species under nearly 70 families used by the local people and indigenous tribes dwelling in the areas mainly to treat various health ailments or for other purposes including as the source of vegetables. The study showed that the ethnomedicinal plant species are used to treat nearly 60 disease categories viz., as anti-cancer, anti-diabetic, anti-inflammatory, analgesic, stomach disorder, anti-arthritis, febrifuge, diuretic, dermal infection, neurological disease, anxiolytic, urinary disease as brain tonic, antioxidant etc.

Elsholtzia blanda (whole plant) and *Litseacubeba* (fruit) have been identified as chemotype source of essential oil rich in linalool (62-80%) and citronellal (84%).







Clerodendrum serratum Osbeckianepalensis Elsholtzia blanda

Project Title: Studying adaptation biology and understanding/exploiting medicinally important plants for useful bioactives (SIMPLE).

Project No: BSC-109

Funding Agency: CSIR

PI & Members: Dr H P Deka Boruah (Nodal Scientist), Dr R Saikia, Dr Jatin Kalita, Dr Anil Kr Singh, Dr M Khongsai

Salient Achievements:

Tree composition, diversity, dominance and carbon stocks in the AGB and soil of tropical forests viz., the Gibbon wildlife sanctuary (GWS) and the Kholahat reserve forest (KRF) of Assam, India were assessed. Soil sampling, tree survey, girth above 1.3 m height of plants >10 cm girth of plants were assessed in 1000 m^2 quadrate. Allometric model for moist forest stands was used to determine AGB and GBC. A total of 71 and 108 different tree species belong to 32 and 42 families were found in the GWS and KRF, respectively. In the GWF, the Shannon diversity index (1.22) and the Simpson index (0.085) were significant, while for the KRF these indices were insignificant. The basal area, AGB and AGBC in the GWS and KRF were 62.49e90.29 m^2 ha^{-1}, 135.30 e146.42 Mg ha^{-1}, and 67.64e73.21 Mg ha^{-1}, respectively. The average soil carbon stock (SOC) in the upper, middle and lower layers was 57.74e78.44 kg m^{-2}, 39.22e64.93 kg m^{-2} and 30.32e42.86 kg m^{-2}, respectively, in the GWS and KRF. However, compared to GWS, a higher AGB and AGBC were found in KRF. This finding reveals that the higher AGB, AGBC and SOC in the KRF were due to old growth matured forest with big and diverse tree species. The forest habitats types in six forest of Assam namely Pobha, Kholahat, Nameri, Dehing Patkai and Upartala while family composition were studied.

Project Title: Introduction, domestication, improvement and cultivation of economically important plants (AGTEC).

Project No: BSC-110

Funding Agency: CSIR

PI & Members: Dr M Lal (PI), Dr B S Bhau, Dr S P Saikia, Dr M Bhuyan

Salient Achievements:

A total of 130 leaf samples of *Cymbopogon*sp were collected from NEIST experimental farm. DNA extraction and quantification of all the collected samples were done. RAPD and ISSR analysis and data scoring of all the analysed samples have been completed.

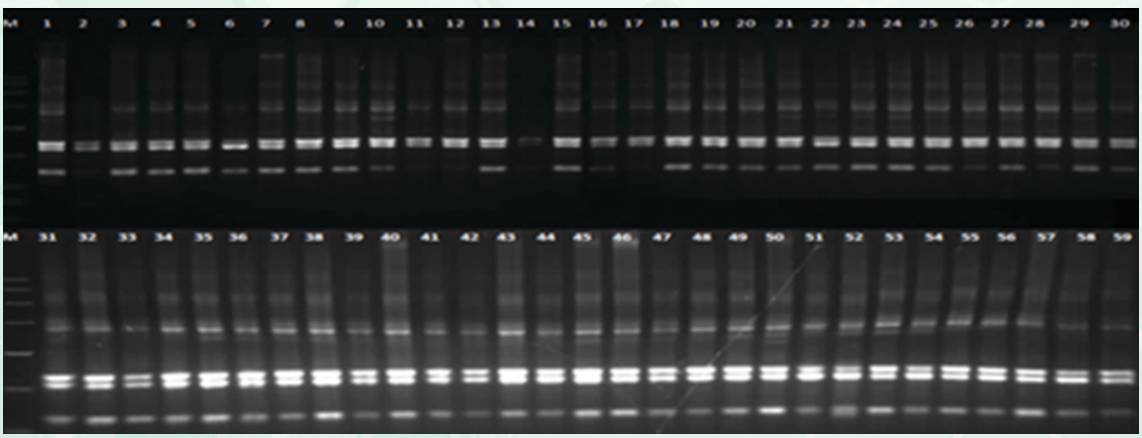


Fig: RAPD analysis of *Cymbopogon* sp. using primer RPi-12

Project Title: Integrated NextGen Approaches in Health, Disease and Environmental Toxicity (INDEPTH).

Project No: BSC-111

Funding Agency: CSIR

PI & Members: Dr Jatin Kalita, PI (WP-I); Dr R Saikia, PI (WP-II); Dr M Bhuyan, PI (WP-III); Dr PR Bhattacharya, Dr TC Bora; Dr HP Deka Boruah; Dr P K Baruah; Dr T Borah; Mr D Ozah

Salient Achievements:

Isolation and characterisation of bacteria from crude oil contaminated soil : We isolated 150 nos. of bacteria from soil sample collected from Digboi oil refinery's areas. Out of these, 10 nos. of bacterial strains were found to be positive in naphthalene, benzo(a)pyrene, phenanthrene degradation. Based on 16S rDNA sequence, few polyaromatic hydrocarbon (PAH) degrading bacterial strains have been identified (NCBI accession no. KP326362, KP326363, KP326364, KP326365). Mass Spectroscopic analysis of metabolite produced in the benzo(a)pyrene containing medium the strain *Bacillus toyonensis* ADG19 degraded benzo(a)pyrene after 48 hrs of incubation. In addition, *in-silico* docking was done to see whether 4-hydroxyphenyl pyruvate was responsible for degradation. It was observed that hydrogen bonds were formed between the protein and the ligand as in figure.

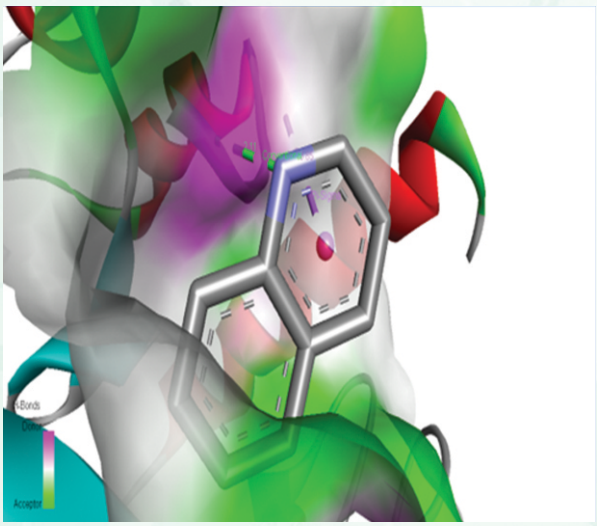


Fig: Docking of 4-hydroxyphenyl pyruvate

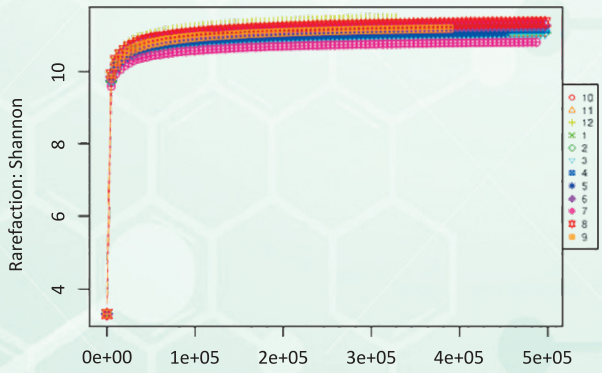


Fig : Rarefaction curve of soil bacterial community by Shanon index of Digboi Oil Refinery areas.

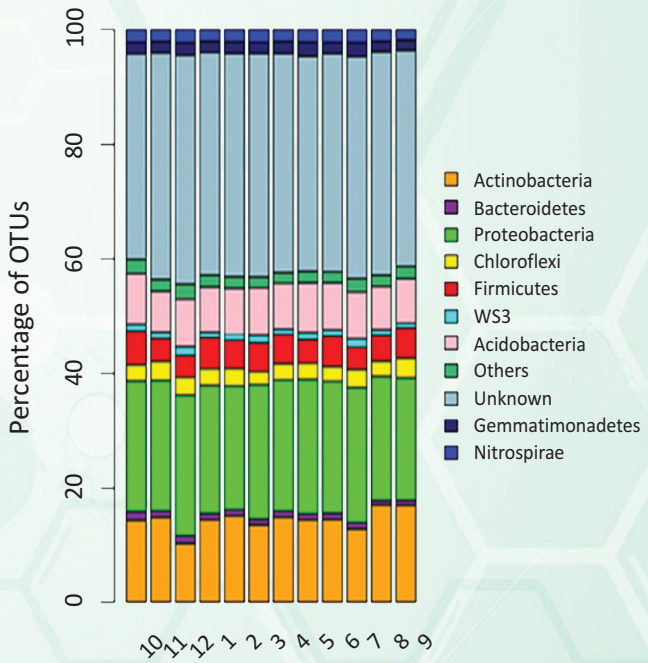


Fig: Operational Taxonomic Unit (OTU) at Phylum level in some samples collected from Digboi Oil Refinery areas (BSC-0111)

Biosurfactant producing strain: Two hundred bacterial strains were screened for different biosurfactant production test. Out of these, 20 strains have ability to produced biosurfactant. The 20 nos. of biosurfactant producing bacteria were identified based 16S rDNA sequence and observed that most of the strains were under *Bacillus* group. Out of the 20 biosurfactant producing strains, 2 strains have ability to degrade crude oil.

Butterfly diversity and abundance around Gas flaring sites: The studies were carried out on Butterfly diversity and abundance around Gas flaring sites in Rudrasagar, Sibsagar district of Assam. Major emission was found to be that of carbon dioxide (CO_2) in the gas flaring sites. Butterfly (*Eurema hecabe*) and host plant (*Cassia tora*) was selected in the study area. Simulation study was done for *C. tora* and the butterfly *E. hecabe* under elevated CO_2 (500ppm) (Fig. 3a & b) and observed that total chlorophyll content decrease under elevated CO_2 open top chamber (OTC) in comparison to control (unpolluted). Specific leaf area increased whereas leaf thickness decreased under OTC than in control (unpolluted). Leaf dry matter content (LDMC) decreases under OTC condition than in the control (unpolluted). Leaf nitrogen content decreases under elevated (500 ppm) CO_2 than in control (unpolluted). However, C/N ratio of *C. tora* grown under elevated CO_2 levels increase. Growth and development studies indicated that larval duration of the butterfly *E. hecabe* was shorter under elevated CO_2 foliage than in control. Moreover Pupal weight was found to be greater in control (unpolluted) than OTC. Consumption rate of the butterfly larvae is more in OTC then in control (unpolluted).

Coagulase activity : Biochemical characterization of the bacterial strain having the coagulating property was performed. Minimal media required for Coagulase production by the bacterial strain was standardized. DNA was isolated and coagulase gene was amplified. The proteins showing clotting of plasma has been further purified to homogeneity. The active proteins having coagulase property is studied for individual amino acids composition by HPLC. Further process of purification & structure elucidation of this protein are in progress for immediate use in health care.

Screening of bacteria having PGPR : Field application of PGPR was applied in mung bean and pea to see their growth effect and yield. A bioformulations was prepared using RB -1, RB - 4 and RB – 5 and the PGPR effects were studied in mung bean and pea. The results showed increased height, early fruiting and number of leaves as well as the biomass content of the treated plants as compared to the control crops. This formulation was found to effective on these two crops. Biochemical analysis for carbohydrate, protein, lipid and free amino acid is in progress for both control and treated cases.

Project Title: Therapeutics of Chronic Obstructive Pulmonary Disease (COPD) and related respiratory disorders (COPD- TREAT).

Work Component at NEIST, Jorhat: Chronic obstructive pulmonary disease: Study of differential immune responses through gene environment interaction.

Project No: BSC-116

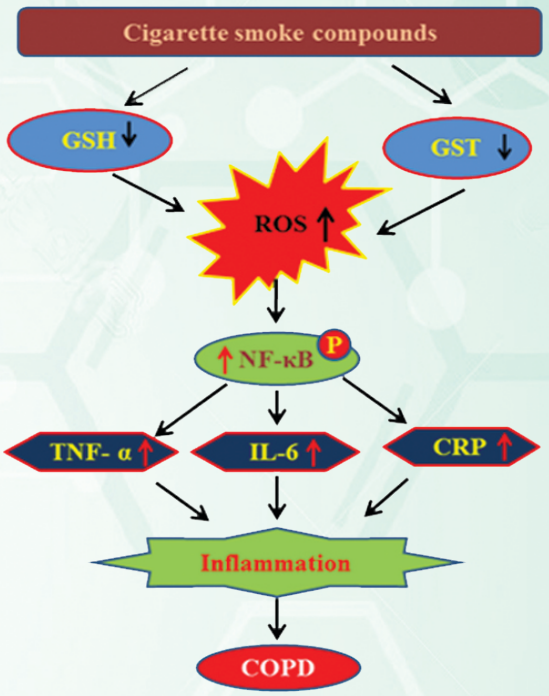
Funding Agency: CSIR, New Delhi

PI & Members: Dr Jatin Kalita (PI), Dr H P Dekaboruah (Co-PI), Dr P K Baruah, Dr T Bora, Mr R C Bharali, Mr D Ozah

Salient Achievements:

Cigarette smoke has always been considered as a risk factor for chronic obstructive pulmonary diseases

(COPD). Under the project, the effect of ten individual cigarettes smoke compounds (nicotine, benzo[a]pyrene, naphthalene, formaldehyde, ammonia, acrylic acid, toluene, benzene, m-xylene, and hexamine) on glutathione S transferase (GST) activity, an important Phase II metabolic enzyme and their possible role in inflammatory pathophysiology leading to COPD has been examined. Lower GSH level and GST activity and higher CRP, TNF-α, and IL-6 levels were observed in COPD patients compared to age-matched controls. Using human recombinant GST and plasma samples collected from normal subjects this study demonstrates that out of the ten compounds, nicotine (5 mg/mL), benzo[a]pyrene (10 ng/mL), naphthalene (250 µg/mL), and formaldehyde (5 pg/mL) caused a significant decrease in both recombinant and plasma GST activity. Further cell culture studies shows that exposure to nicotine, benzo[a]pyrene, naphthalene, and formaldehyde caused a significant decrease in GSH levels and GST activity and its protein expression and an increase in intracellular ROS production in THP-1 monocytes. Interestingly, treatment with benzo[a]pyrene and naphthalene significantly upregulated the phosphorylation of the p65 subunit of NF-κB and increased the secretion of TNF-α and CRP compared to control. This study suggests the potential role of benzo[a]pyrene and naphthalene in activation of the inflammatory signaling pathway leading to cigarette smoke-induced COPD.



Project Title: Role of ACC-deaminase producing PGPR on alleviation of water stress affect in pulse crops (RAWS, under PMSI).

Project No: BSC-117 (A)

Funding Agency: CSIR, New Delhi

PI & Members: Dr Ratul Saikia (PI), Dr H P Deka Boruah (Co-PI), Dr T C Bora (Co-PI)

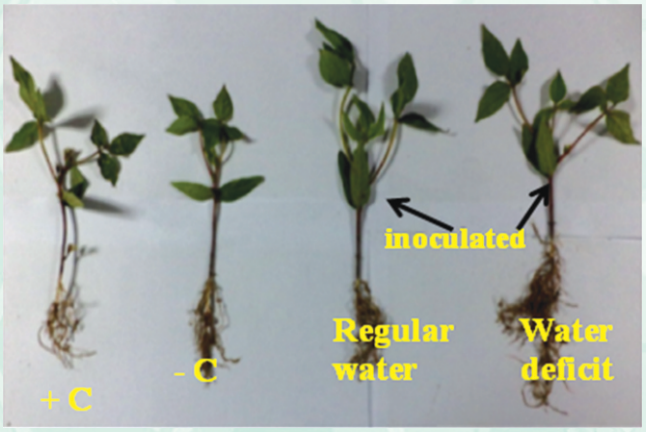
Salient Achievements:

Isolation and identification of ACC deaminase producing bacterial isolates- A total of 80 numbers of ACC deaminase producing bacteria were isolated from pulse rhizospheric soil in the vicinity of Jorhat, Assam. On the basis of 16S rRNA gene sequence analysis, majority of them were phylogenetically affiliated to the genera *Pseudomonas*, *Burkholderia*, *Bacillus*, *Ochrobactrum*, *Serratia*, *Comamonas*, *Staphylococcus* and *Klebsiella.* All the positive strains were tested for its plant growth promoting characters like production of IAA (60%), NH_3 (90%), and siderophore(30%), phosphate solubilizatio (70%), antifungal property etc. Amongst these, three isolates identified as *Ochrobactrum pseudogrignonense* RJ12, *Pseudomonas* sp. RJ15 and *Bacillus subtilis* RJ46 with multiple growth promoting attributes, exhibited high ACC deaminase enzyme activity of 84 nmol $mg^{-1}hr^{-1}$, 57 nmol $mg^{-1}hr^{-1}$, 125 nmol $mg^{-1}hr^{-1}$, respectively and upto 20% osmotic stress (PEG inducted) tolerance capacity. They also promoted black gram seed germination under high water potential of-

0.5MPa. Based on these results the three isolates were selected for pot experiments under greenhouse condition which sowed appreciably high plant growth in puse crops compared to uninoculated control. Subsequently these strains were further tested for pulse growth promotion under field condition. Details study of evaluation is in progress.

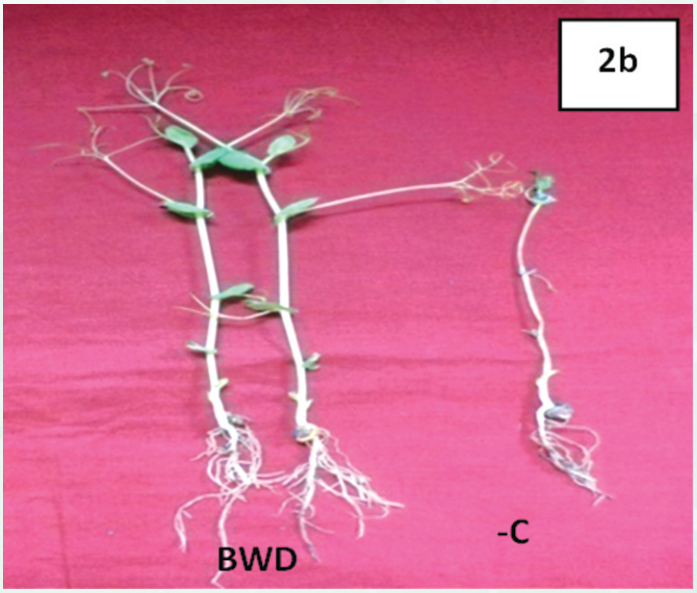






Photograph: A view of field experiment on Black gram field experiment (1a); morphological comparison of black gram plantlets in regular water and deficit condition (+C = Positive control/Un-inoculated regular water plants, – C = Negative control/Un-inoculated water deficit plants, BRW (bacteria treated regular watered plants), BWD(Bacteria treated water-deficit plants)





Photograph: A view of coordinated field experiment on green-pea (2a); morphological comparison (2b) of treated plants under water deficit condition with un-inoculated negative control (- C= negative control/uninoculated water deficit plants, BWD= Bacteria treated water deficit plants).

Project Title: Management of Nematode infection and genome wide expression profiling for biomass and oil yield improvement in patchouli through root associated bacteria.

Project No: BSC-117 (B)

Funding Agency: CSIR

PI & Members: Dr BS Bhau (PI), Dr SB Wann, Dr RK Sharma

Salient Achievements:

Rice husk as carrier and PGPR strain *Pseudomonas putida* BGS2 were used for the carrier -based bioformulation for the field application on patchouli plants. A specific amount of bioinoculant formulation was applied on the patchouli plants at different intervals of time. Different growth parameters were monitored on the tested and controlled patchouli plants after bioformulation treatment. The data on the different growth parameters are presented on the graph. From the data we observed that the no. of leaves and branch on the treated plants are more in comparison to the control plants. But slight increase in the height was observed on the treated plants as in figure.

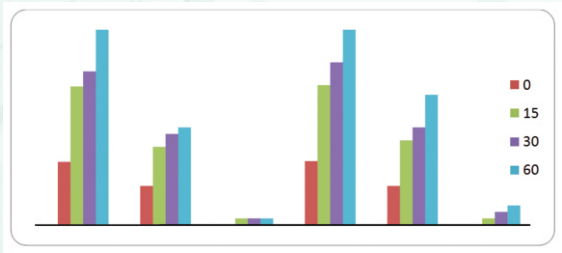


Fig. Effect of rice husk-based formulation of *Pseudomonas putida* on different growth parameters of patchouli plants at different time intervals

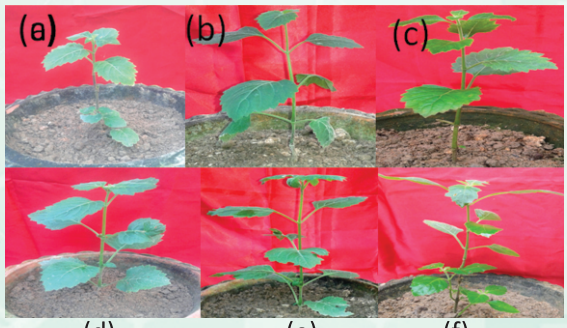


Fig. Patchouli plants (control) (a) 15, (b) 30, (c) 60 days and treated (d) 15, (e) 30, (f) 60 days after PGPR containing bio-formulation.

Gene expression Analysis using qRT-PCR: Total RNA extracted using Trizol reagent from patchouli plant leaves of different treatments and cDNA synthesis. Selection of suitable housekeeping genes for normalization of qRT-PCR data. Selection of gene of interest based on pathogen related protein and different sesquiterpene synthesis enzymes from available databases and designing of primers. Gene expression analysis using qRT-PCR data of the PGPR treated patchouli plant upon infection with nematode (*Meloidogyne incognita*) to understand the exact mechanism of the induced systematic resistance.

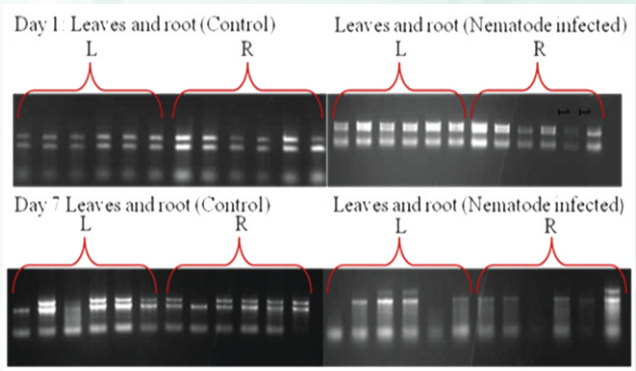


Fig. Extracted total RNA from leaves and root (Normal and control) for housekeeping gene selection.

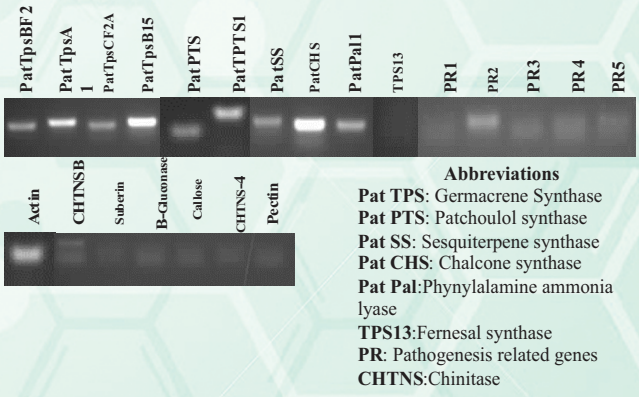


Fig.Standardization of primers designed in our lab for RT-PCR

Project Title: S&T interventions to combat malnutrition in women and children.

Project No: BSC-125

Funding Agency: CSIR

PI & Members: Dr S P Saikia (PI), Mr Tobiul Hussain

Objective:

- Assessment of the nutritional status and dissemination of the identified technologies to alleviate malnutrition.
- Create awareness of the identified technologies amongst the poor villagers of the targeted villages.
- Build a self-sustainable model in the targeted villages.

Salient Achievements:

Some of the beneficiaries trained for mushroom cultivation and its value addition are ready to showcase their products. Swasth Bharat mission, aims at providing affordable health services to all and immunization of children to bring down the mortality rate from 28 to single digit. Mushroom and its product's prepared by different beneficiaries are rich in vitamin D, minerals (calcium, phosphorus and potassium) and folic acid which is of vital importance for treating anaemic condition in the human body in addition to catering health benefits. Daily consumption of mushroom and its value added products will help to fill the gap of protein and micronutrient deficiency and at the same time will enable the population to live a healthy life.In our demonstration of the developed technologies, 100 households have been benefitted under the project.

Project Title: Biocatalyst for Industrial Application & Green Organic Synthesis (BIAGOS).

Project No: CSC-106

Funding Agency: CSIR, New Delhi

PI & Members: Dr. SB Wann (PI)

Salient Achievements:

Isolation of one hundred and fifty fungal strains from forest soil samples collected from Gibbon Wildlife Sanctuary, Jorhat. Forty fungal strains were selected to screen for biotransformation of artemisinin. The biotransfored product were detected through TLC (thin layer chromatography) using ethyl acetate and hexane in the ratio 1:5 (EA/Hexane) as solvent system. Four strains were able to produce metabolite polar than artemisinin while and strain (4RB2) was selected for biotransformation and extraction of compound was done using fungal broth culture containing artemisinin. The unknown crude product was purified by Column Chromatography and purity checked by TLC in Ethyl acetate: Hexane (8:2). Unknown product was characterized by 1H NMR, 13C NMR, Mass & IR spectroscopy and was identified as Deoxyartemisinin, a derivative of artemisinin. The strain 4RB2 is identified as *Penicillium citrinum* (MTCC12422), a commonly occurring filamentous fungus. Details of extra spot and NMR spectra are described in the following figure.

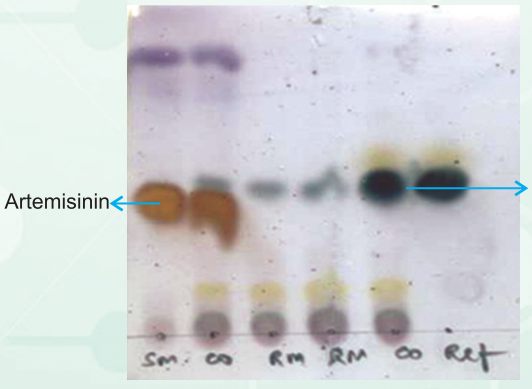


Fig. : TLC confirms the product Deoxyartemisinin

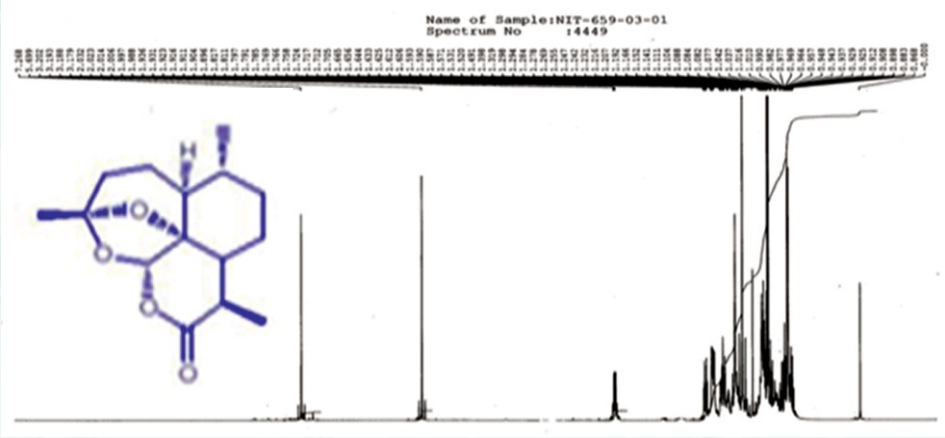


Fig.: Unknown product was confirmed as deoxyartemisinin through NMR Spectroscopy

Project Title: Development of sustainable processes for edible oils with health benefits from Traditional and new Resources.

Project No: CSC - 112

Funding Agency: CSIR

PI & Members: Dr S P Saikia (PI), Dr Dipanwita Banik, Ms Rumi Kotoky

Salient Achievements:

Extractions of seed samples of 55 plant species have been carried out, of which seed samples of 20 plant species have exhibited oil yield ranging from 10% - 50% while nine plant species of less known category (NST 20, NST 24, NST 28, NST 31, NST 32, NST 37, NST 39, NST 42, NST 48) resulted yield ranging from 27% - 50%. Physicochemical properties of fatty oils of the seeds of 47 plant species and mineral contents in the oils obtained from the seed samples of 16 species have been evaluated. Compositions of Fatty acids for the seed samples of 33 plant species have been analyzed. Eleven plant species of less known category with the oil yield above 10% recovery exhibited encouraging results. Three plant species (NST 20, NST 24, NST 42) are found to be rich in C12 fatty acids (56-85%), while two species (NST 32, NST 39) for C 16:00 fatty acids (36%-44%), four plant species (NST 28, NST 37, NST 48, NST 66) for 18:1 fatty acids (46%-75%) and two plant species (NST 11, NST 22) for 18:2 fatty acids (31%-49%) have been identified.



Fig: Most Promising Result: NST 24 (*Litseacubeba)*

Project Title: BioEn.

Work Component at NEIST, Jorhat: Screening of efficient algal species from North-East India for biomass culture to be utilized for biofuel/ biodiesel production.

Project No: CSC-116

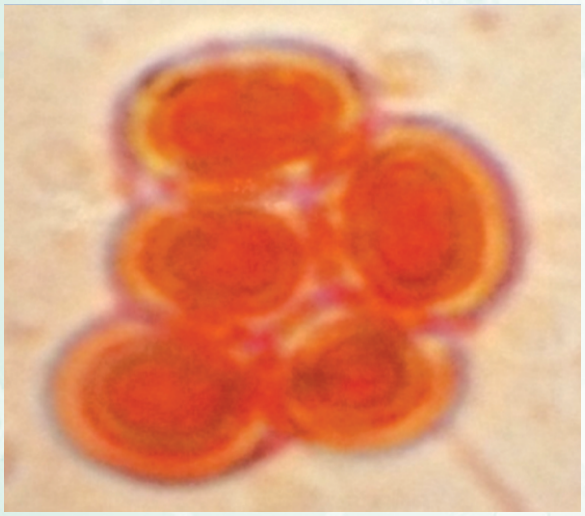
Funding Agency: CSIR

PI & Members: Dr H P Deka Boruah (Nodal Scientist), Dr R Saikia, Dr Pinaki Sengupta

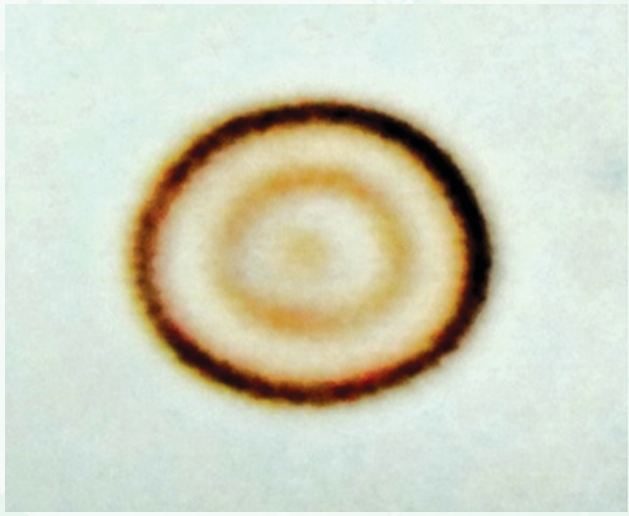
Salient Achievements:

Freshwater microalgae from different districts of Assam viz., Nagaon, Golaghat, Karbi Anglong were collected. Of these 7 *Gloeocapsa,* 8 *Anabaena species, 20 Chlorella species,* and *11 Spirulina* species were screened. Screened strains were assayed for their subsistence under varied conditions. All the 4 freshwater microalgae viz. *Anabaena, Gloeocapsa, Spirulina, chlorella* produced biomass in varying amount. Lipid, chlorophyll a, chlorophyll b as well as total chlorophyll were also assayed in *Anabaena, Gloeocapsa, Spirulina, and Chlorella*. Detail study is in progress for large scale biomass production.

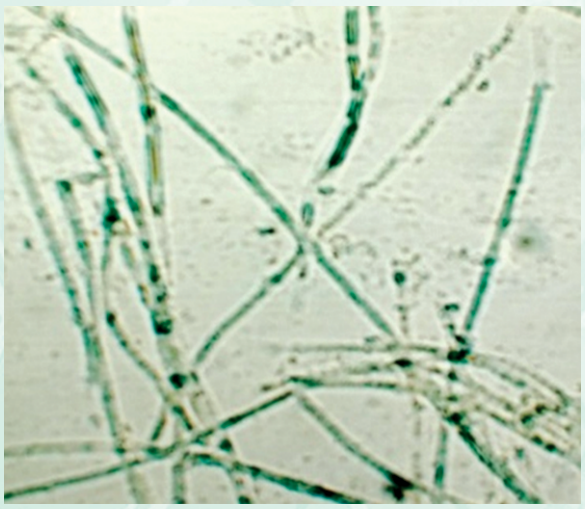
FIGURE 1. MICROSCOPIC VIEW OF THE SCREENED MICROALGAE:



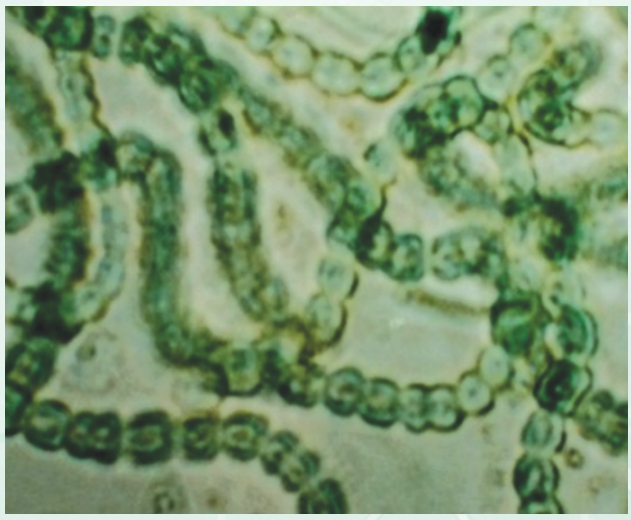
Gloeocapsa



Chlorella



Spirulina



Anabeana

Project Title: Development of new antituberculosis molecules using microbial resources of North East gene pool.

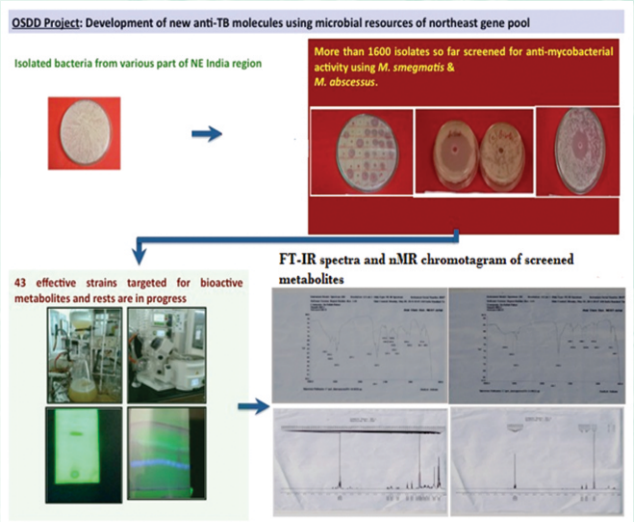
Project No: HCP0001-OSDD

Funding Agency: CSIR

PI & Members: Dr Anil Kr Singh (Co-PI), Dr H P Deka Boruah (Co-PI)

Salient Achievements:

Screened 1500 bacterial strains isolated from different ecological niche for the anti tb activities against test organism *Mycobacterium smegmatis* and *Mycobacterium abscessus*. Among them 43 bacterial isolates that are showing good activity against both the mycobacterial strains. Bioactive metabolites extraction and their identification from six effective strains have been done (As shown below) and detail of mode of action is in progress.



Project Title: Field demonstration of region specific Medicinal & Aromatic plants genotypes of CSIR for socio-economic upliftment of masses in J&K region (J&K AROMA AROGYA GRAM-JAAG).

Project No: RSP-4001

Funding Agency: CSIR

PI & Members: Dr S P Saikia (PI), Dr Mohan Lal, Mr Sanjoy Kumar Chanda, Mr Himangshu Lekhak

Objectives:

- Field level demonstration of region specific superior genotypes of CSIR R&D work on Medicinal & Aromatic plants on higher scale in Jammu & Kashmir region.
- Skill development, technology transfer and employment generation through CSIR technologies.
- To provide proven business model based on CSIR MAPs technology for adoption by masses.

Salient Achievements:

68,600 slips were distributed and planted in Reasi district covering 2.5 ha area and 40,200 slips were distributed and planted in Pallan area of Kathua district covering 1.0 ha area. A total of 3.5 ha area were covered by CSIR-NEIST under citronella plantation in Jammu.

Project Title: Rural Entrepreneurship and Skill Development through Demonstration and Training of Appropriate Technologies of CSIR-NEIST.

Project No: RSP - 4007

Funding Agency: CSIR

PI & Members: Dr S P Saikia (PI), Dr Pranab Barkakati, Mr Dipankar Neog, Dr T Goswami, Mr J J Bora

Objectives:

- Creating a rural technology demonstration

set-up for live demonstration of appropriate rural technologies of CSIR-NEIST.

- To demonstrate different rural technologies to the entrepreneural youths with lab to market approach.
- To impart skill development training programme for rural youth in different categories.
- Awareness programe for financial linkage, trade build-up and market linkages for the trained entrepreneurs.

Salient Achievements:

Rural Entrepreneurship & Skill Development Centre (RE & SDC) of CSIR-NEIST has been established which will provide for this part of the country, a common platform which can be used to utilize/mobilized the 6M factors (manpower, money, material, machinery, management and market) effectively necessary for Rural Entrepreneurship Development (RED). Skill development training programme for rural youth in different categories has been undertaken under the project.

(ii) In-house, Grant in aid & Consultancy Projects

Project Title: Bio-profiling and bio-prospecting microbes, plants and insects from North East gene pool and their application potentials.

Project No: MLP - 2000

Funding Agency: CSIR-New Delhi

PI & Members: Dr H P Deka Boruah (PI), Dr S B Wann, Dr Ratul Saikia, Dr Jatin Kalita, Dr Anil Kr Singh, Mrs Archana Yadav, Mrs Palakshi Bordoloi

Salient Achievements:

Soil samples from different locations covered with varied vegetation types were collected. Disturbed sampling was done from three layers the surface layer 0-10 cm, middle layer 10-20 cm and sub-surface layer 20-30 cm, respectively. More than 1000 soil samples from different locations were collected and screened for microbes by following standard protocol. Microalgae were also sampled in the same survey and subculture, purification and optyimisation of cultivation were performed. During collection vegetation studies were performed to predict biodiversity, nature and carbon stocks. At present we have >700 important bacterial strains and investigation is on for exploiting different biological activities under specific objectives.

Project Title: Sustainable Utilization of medicinal, aromatic, aquatic and economic plants: b) Development of agro-technology & chemical investigation of selected medicinal, aromatic and edible plant of Arunachal Pradesh.

Project No: MLP-8000 (B)

Funding Agency: CSIR

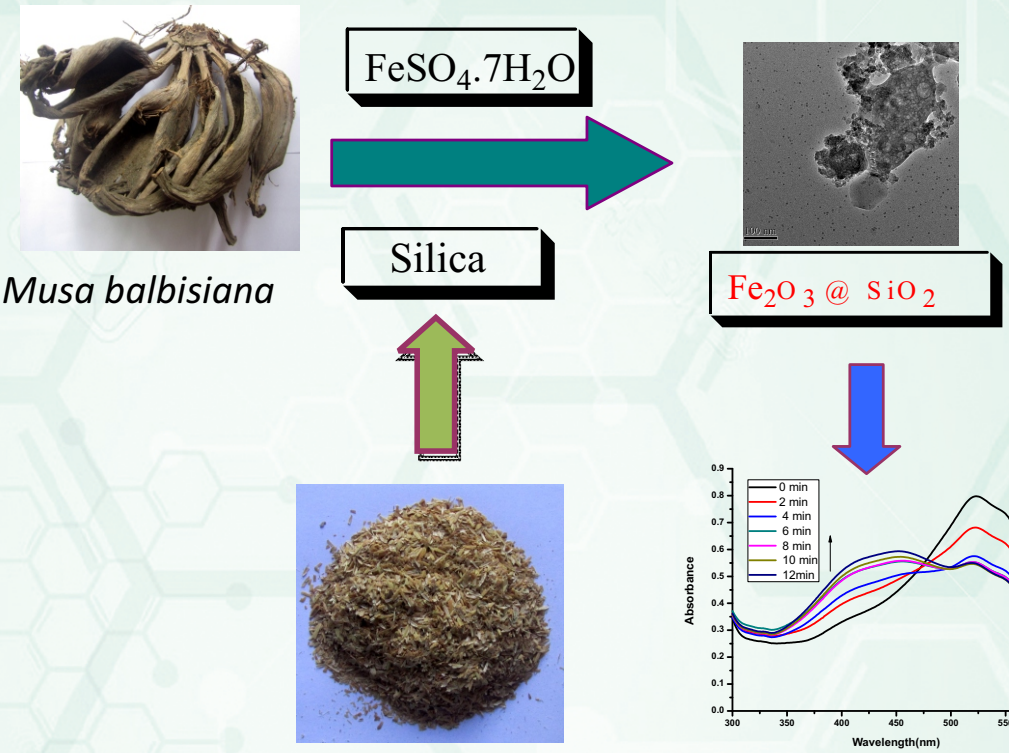
PI & Members: Dr Chandan Tamuly (PI), Dr B C Baruah, Jayanta Bora, M Hazarika

Salient Achievements:

- A new strain of lemon grass (BLI-ARUN) developed About 25-35% increase of essential oil content has been achieved having 1.2-1.6% of essential oil.
- Eight nos. of training programme on 'cultivation of mushroom' and 'production of vermicompost' was organized.
- Nutritional value was evaluated for the ten nos. of edible plants from Arunachal Pradesh.
- The beneficiaries earned more than 1, 20,000/- by selling mushroom and 1,10,000/- by selling vermicompost.

- Three nos. of training programme on "cultivation of medicinal, aromatic and economic plants" were organized.

Synthesis of Fe_2O_3@SiO_2 using plant resources and its application: Biosynthesis of Fe_2O_3@SiO_2 nanoparticles with an eco-friendly, green approach is reported here. The Fe_2O_3@SiO_2 nanoparticles was efficiently used as a photocatalyst for degradation of methyl red (MR) dye. The results revealed that the Fe_2O_3@SiO_2 showed significant photocatalytic activity compared to SiO_2, Fe_2O_3 and Fe_2O_3@SiO_2 (commercial) nanoparticles/ nanocomposite.



Project Title: Creation and development bioinformatics infrastructure facility in North East India.

Project No: GAP-200

Funding Agency: DBT, New Delhi

PI & Members: Dr Ratul Saikia (PI & Coordinator)

Salient Achievements:

Human Resource Development: The Centre has so far trained more than 10 Research Scholars, PG/UG Students, and Teachers in Genomics, Proteomics, Phylogenetic analysis, Computer aided drug design and other applied areas of Bioinformatics.

Monthly Bioinformatics Bulletin: The centre is continuously publishing its monthly newsletter "*Bioinformatics Upto Date*" from June 2008 to till this month continuously in NEIST official website (http://www .rrljorhat. res.in / biotechnology. html). We are continuously getting good feedback from different R&D organizations with their motivational view. The new edition of news letter is under construction.

Workshops and Trainings : A 3 days workshop cum hands on training on biological data analysis has been successfully organized at bioinformatics centre, BSTD, CSIR-NEIST on 8-10 December, 2015 by the support of DBT, Govt of India. Two students of Tezpur University successfully

completed their one month Summer Training program for month of June, 2015. Another two students from Annamalai University has also completed their bioinformatics summer training works successfully during June-July, 2015.

Project Title: Establishment of Institutional Level Biotech Hub by DBT special programme for NE states.

Project No: GAP-246

Funding Agency: DBT, New Delhi

PI & Members: Dr Ratul Saikia (PI)

Objectives:

- Conduct trainings and workshops in areas related to Biotechnology for students, faculties of nearby institutions, colleges etc.

Salient Achievements:

DBT Institutional Biotech Hub Training-cum-Workshop on Basic Molecular Techniques for Microbial Genotyping, 24-25 Feb, 2016: A 2 days Training-cum-Workshop on Basic Molecular Techniques for Microbial Genotyping has been successfully organized at BSTD, CSIR-NEIST on 24-25th February, 2016 by the support of DBT, Govt of India. There are total of 50 participants joined in the workshop coming from different parts of Assam. The workshop mainly focused on different Molecular Methods for Microbial Diversity, Genotyping, Gene cloning, Cancer etc. Techniques like DNA banding pattern, Box-PCR, RFLP, 16S r RNA sequence analysis, Metagenomics analysis etc were discussed and hands on training session also successfully organized for the different genotyping methods.

Project Title: A study on Taxonomy and Ethnobotany with an emphasis to biochemical parameters of the family *Myristicaceae* R. Br. In North East India.

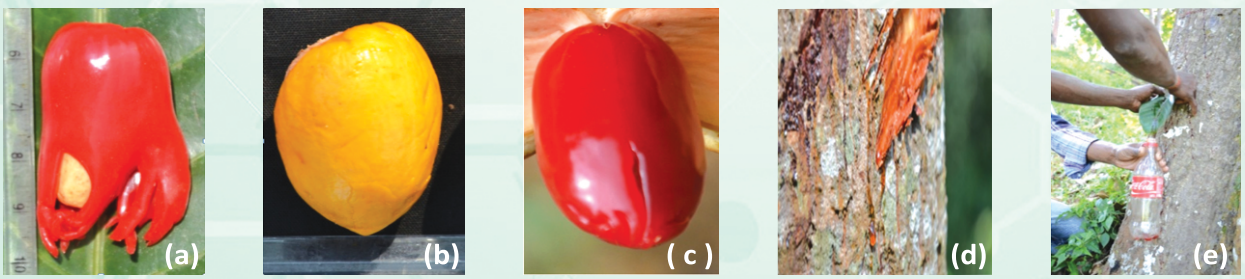
Project No: GPP-262

Funding Agency: DST

PI & Members: Dr Dipanwita Banik (PI)

Salient Achievements:

A taxonomic study on the family Myristicaceae in North East India based at CSIR-NEIST (2012 – 2015) confirmed that 3 genera viz., Endocomia W. J. de Wilde, HorsfieldiaWilld. andKnemaLour are distributed in North East India along with 9 species in tropical to subtropical primary forests. The ethnobotanical information were recorded and compiled from primary and secondary sources including their vernacular names in 15 languages and revealed that the seeds, aril, latex of different species are used substitute of areca nut as masticator and to treat infections of throat and stomach. The study also confirmed the presence of variation in phytochemical constituents along with their taxonomic characters in between *H. kingii*and *H. amygdalina*.



The seeds covered with aril in (a) *E. macrocoma* subsp. prainii (b) *H. kingii* (c) *K. linifolia*(d) The red latex from the bark in *H. amygdalina* and (e) *H. kingii*

Project Title: DNA Fingerprinting of Endophytic Actinomycetes Isolated from Protected Forest Areas of Assam and Mizoram.

Project No: GPP-265 (DBT-Twinning)

Funding Agency: Department of Biotechnology (DBT), New Delhi

PI & Members: Dr Ratul Saikia (PI), Dr Tarun C Bora (Co-PI), Mrs Archana Yadav

Salient Achievement:

Isolation and identification of endophytic actinomycetes

Total more than one hundred endophytic actinobacterial strains were isolated from different medicinally important plant samples collected from Gibbon Wild Life Sanctuaries, Jorhat and Kaziranga National Park. Taxonomic position has been determined based on 16S rDNA sequence and submitted to NCBI GenBank. Accession numbers are obtained for 76 endopyhtic actinomycetes (KF011550, KF011551, KF021229, KF703719, KF703720, KF703721, KF703722 etc.). Fifty five number were found positive antimicrobial activity against the test pathogens, *Staphylococcus aureus, Escherichia coli*, *Pseudomonas syringae*, *P. aeruginosa*, *Candida albicans, Fusarium oxysporum*, *Rhizoctonia solani* and *Aspergillus niger*. These bioactive strains were further screened for biosynthetic genes, *viz. PKSI*, *PKSII* and *NRPS* and showed prevalence of polyketide synthase type II (*PKSII,* 80%) followed by polyketide synthase type *I* (*PKSI*, 3%) and NRPS gene. The expression level of both *PKSI* and *PKSII* genes were analyzed by real-time qPCR for few promising strains. The study revealed that the bioactive strains were highly expressed as compared to inactive strains. A comparision were also done with respect to season and found that abundance of endophytic actinomycetes were found to be higher in summer season.

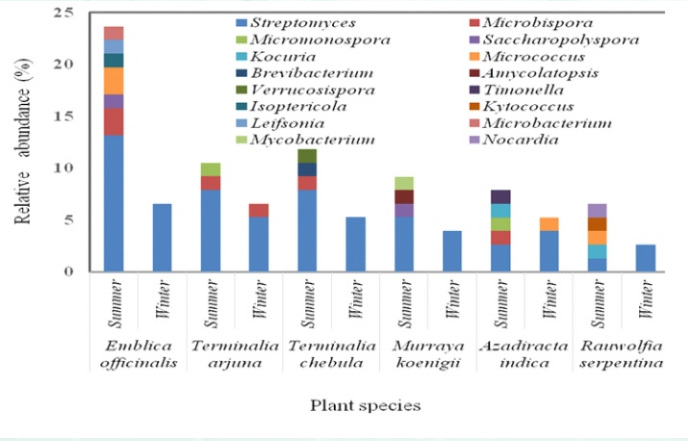


Fig. The relative abundance of endophytic actinomycetes in some medicinal plant species in summer and winter seasons (Gohain et al., *FEMS Microbiol. Lett,* 2015)

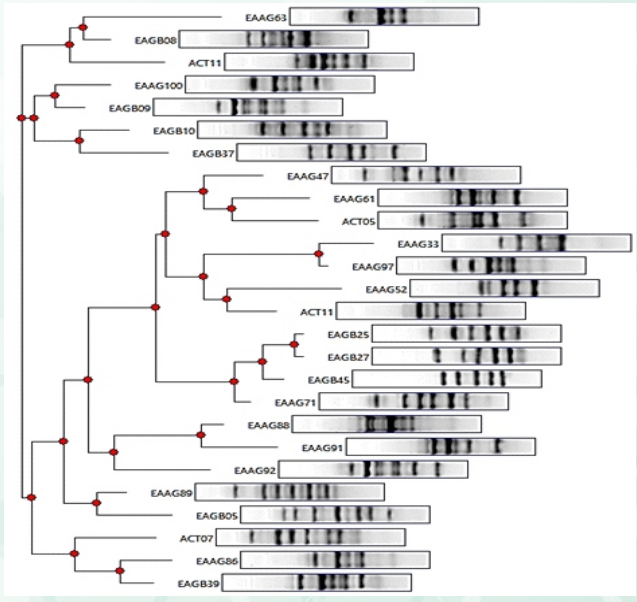


Fig: Dendrogram showing the genetic diversity of some endophytic actinomycetes isolated from Gibbon Wild Life Sanctuary (derived from NJ cluster analysis).

Project Title: Detoxification of mustard seed based product through fermentation process based on North East traditional practice and their value addition.

Project No: GPP- 271

Funding Agency: DBT, Govt. of India

PI & Members: M Khongsai (PI)

Salient Achievements:

- Collection of samples: Survey and collection of fermented mustard seed products Kahudi, Kharali and Panitenga were carried out extensively and collected 45 samples from various parts of North east. The samples are Assamese community based traditionally prepared mustard seed fermented products. The mustard seed fermented products are used as the source of microbial isolation.
- Isolation of microbial strains: Isolation, screening and production of glucosinolate degrading microbial strains were carried out using sinigrin and traditionally prepared fermented mustard seed recipes (Kahudi and Kharali). A total of 300 bacterial strains have been isolated from the traditionally prepared fermented mustard seed recipes using Nutrient agar media and Sauton's agar media by serial dilution tchniques. The pure cultures are maintained at Nutrient agar/Potato Dextrose agar media.
- Screening of microbes for production targeted enzymes and developing consortia (myrosinase enzyme): Detoxification of mustard seed food supplements was done by supplementing the consortia for production of myrosinase enzyme. The isolated bacteria were used as principle supplement for the degradation of the glucosinolate compound present in the finished products. The available glucosinolate compound sinigrin (allyl glucosinolate) is used as the available substrate to compare with the mustard seed cake. The degradation of glucosinolate compound by the bacteria is visually checked by the viscosity of the production media. The target was to develop supplementing consortia for production of myrosinase enzyme which can simplify the glucosinolate compound into simpler form of allyl isothiocyanate (AITC) and sugar.

  The production media was standardized using different parameters such as nitrogen sources, carbon sources, pH, temperatures, incubation period etc.

Project Title: Studies on drought resistance strategy in seedlings of Teak (*Tectonagrandis* L.) species and selection of improved genotype for forest management.

Project No: GPP - 272

Funding Agency: DBT

PI & Members: Dr SP Saikia (PI)

Salient Achievements:

Drought tolerant (DT) and sensitive (DS) genotypes of *Tectonagrandis*, selected based on Vegetative Characteristics Measurements, viz. transplant length, leaves number per transplant and leaf area; Physiological Measurements, viz. transpiration rate, stomatal conductance, net photosynthetic rate, relative water content, intrinsic water use efficiency, instantaneous water use efficiency, leaf area ratio, specific leaf area, root: shoot ratio and plant biomass and Leaves Chemical Constituents Measurements, viz. nitrogen,

phosphorous, potassium, calcium, sodium, chloride, proline, chlorophyll content were analyzed for global gene expression. Stress related unigenes were highly enriched in DT. In stress related pathways heat shock proteins, disease resistance protein and osmotine were major one and up regulated in DT plants. Analysis of hormonal pathways reveled that auxine, zeatine and ethylene pathway related enzymes were up regulated in DT whereas abscisic acids and brassinostaroids related unigenes were up regulated and enriched in DS plants. Further, we identified 261 and 247 putative transcription factors from DT and DS, respectively. The major transcription that were up regulated in DT were MYB related family protein, GroES-like zinc-binding alcohol dehydrogenase family, disease resistance protein (TIR-NBS-LRR class) family and WRKY family protein. The transcription factors that were up regulated in DS library were HD-ZIP family protein, DNAJ homologue 2, BED zinc finger hat family dimerisation domain and ERF family protein The major transcription factor that are up to seven fold up regulated in DT, like TIR-NBS-LRR class, WRKY family protein and NAC family protein known to be involved in drought . These results indicate that WRKY family protein and NAC family protein that might play important roles for drought tolerant.

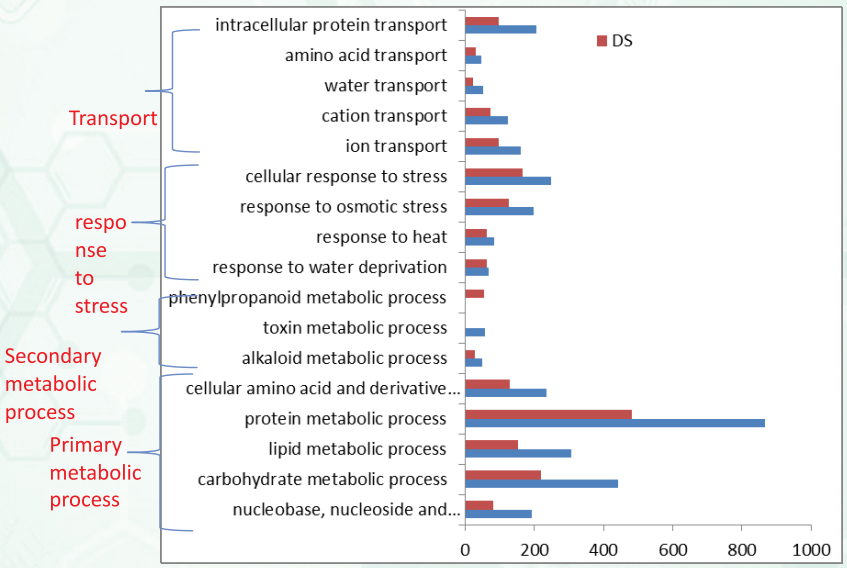


Fig. Analysis of pathways and its enrichment which known to be affected by drought

Project Title: Exploration & Utilization of wild edible plants consumed by ST people of Arunachal Pradesh for socio economic development of the state.

Project No: GPP- 274

Funding Agency: DST, New Delhi

PI & Members: Dr Chandan Tamuly (PI), Jayanta Bora (Co-PI), Moushumi Hazarika

Salient Achievements:

- Prioritization of wild edible plants used by ST of Arunachal Pradesh was done which have medicinal and nutritional properties.
- The nutritional value of fifteen nos. the selected edible is evaluated.
- Mineral contents of fifteen nos. of the selected plants also evaluated.
- The antioxidant activities, phenolic and flavonoid content of the said selected plants are evaluated.

Project Title: Economic and Biogeography Evaluation of theCinnamomum Species in some selected parts of India through Morphological, Chemical and Molecular Biology Study.

Project No: GPP- 280

Funding Agency: DBT

PI & Members: Dr BS Bhau (PI), Dr Dipanwita Banik

Salient Achievements:

40 samples of *Cinnamomumtamala* were collected from NEIST- experimental farm and DNA extraction of those samples were done. Those extracted DNA samples were taken for RAPD and ISSR analysis using 12 primers each. After that, data analysis of resulted RAPD and ISSR products were also been done.

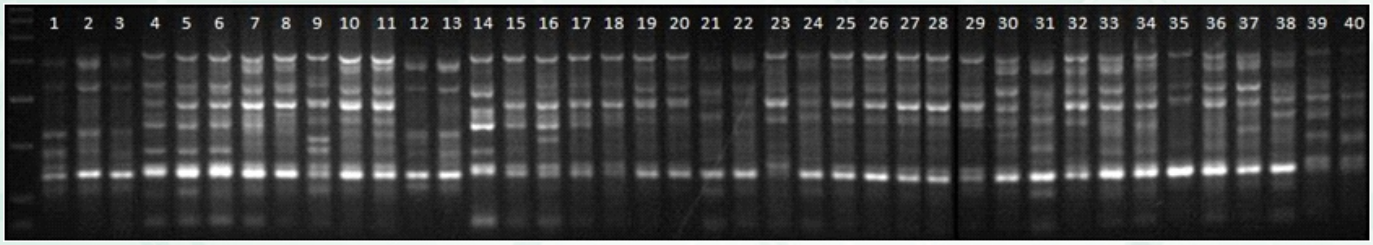


Fig. RAPD of the samples using primer Rpi-25

DNA extraction of 24 samples of *Cinnamomumimpressinervium* was done which have been collected from NEIST- experimental farm. RAPD of 26 samples i.e. 24 extracted DNA samples of *C. impressinervium* along with 1 sample each of *C. asomicum* and *C. bejolghota* previously collected is going on.

Project Title: Induction of systemic resistance through root associated bacteria in Patchouli (*Pogostemon cablin* Benth.) and management of nematode.

Project No: GPP-285

Funding Agency: DST, New Delhi

PI & Members: Dr S B Wann (PI)

Salient Achievements:

- Soil samples collected from the rhizospheric region from different cropping systems of the Patchouli (*Pogostemon cablin* Benth.) and undisturbed soils in CSIR-NEIST Jorhat using aseptic bags. The bacterial strains were isolated were isolated by dilution method and streaked in nutrient agar. A total of 120 morphologically different bacterial colonies were isolated from soil samples and maintained in Nutrient agar, Potato Dextrose agar, Kings' B and Yeast Malt agar (YM agar) media.
- The selected bacterial isolates were characterized by Gram's reaction, and biochemical test using biochemical kit (HiMedia) for Catalase activity, Oxidase test, Amylase activity, Nitrate reduction test, Indole production test, Urease production test, Carbohydrate fermentation, H_2S production, and Citrate Utilization Test as per the standard methods.
- The bacteria were isolated and *in vitro* screening was done for different plant growth promotion

activities i.e. tested for antagonism against phytopathogenic fungi and for their abilities to solubilize phosphate, production of IAA, production of Siderophore (Iron Sequestration), HCN production, catalase activity and Fluorescent pigments.

- The bacteria isolated showing maximum plant growth promotion activities were further identified on the basis of colony morphology, Gram staining and biochemical tests. The selected bacterial isolates showing different plant growth promotion activities were then assessing *in vitro* for effectiveness against nematodes infection in Patchouli in pot experiments in green house condition. The bacterial strains showing positive results were identified by 16S rDNA.
- A survey was conducted in NEIST Campus (Jorhat District), Kaliabor (Nagoan District), Tezpur (Sonitpur District) and Sivasagar (Sivasagar District) for nematode infection (*Meloidogyne incognita*) in Patchouli plants and isolated eggs/larvae were collected and maintained in vegetable crops, mainly tomatoe and brinjal plants. The PGPR strains showing positive tests for effectiveness against nematode infection in Patchouli saplings were used in pot experiments in the green house condition. The application studies of PGPR strains on Patchouli in green house and field condition is in progress.

Project Title: Isolation and characterization of Antifungal peptides from Mug Silkworm *Antheraea assama* Helfer.

Project No: GPP-290

Funding Agency: DBT's Twinning Programme for the NE region in collaboration with Central Muga-eri Research & Training Institute, Central Silk Board & Indian Institute of Technology, Kharagpur, West Bengal

PI & Members: Dr Jatin Kalita (PI)

Salient Achievements:

5th instar larva were immunized with the fungal solution (62000 cfu/ml) through a Hamilton microsyringe of capacity of 2µl to 25 µl. Equivalent larva were reared as control. Collected hemolymph from larva & subsequently from pupa (treated & control) for analyzing whether any additional protein has been synthesized by the larvae or pupae. All the samples were subjected to SDS PAGE along with medium range marker. Results obtained from SDS PAGE, it is confirmed that 9th day old pupa has produced the induced protein.

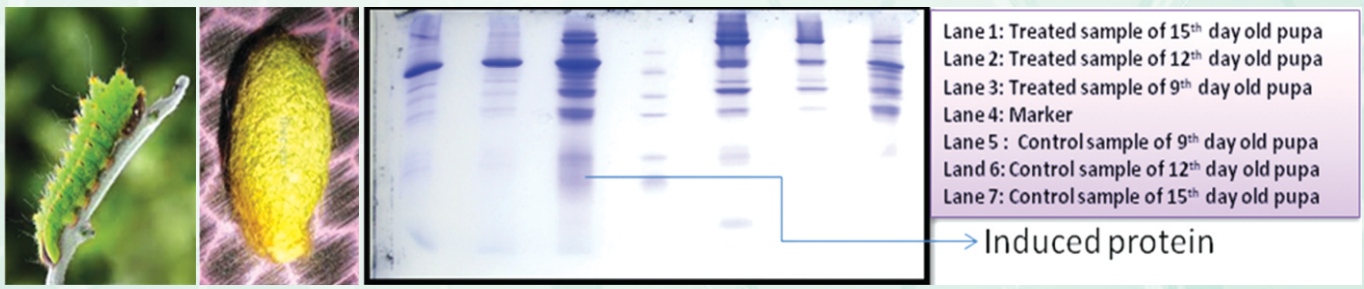


Fig: Induced protein/peptide by the 9th day pupae of silkworm, *A assamensis*

Project Title: DNA-Fingerprinting of Lignocellulose Degrading Microbes Isolated from Protected Forest Areas of Assam and Mizoram.

Project No: GPP-291

Collaborating University/Institute: Mizoram University, CSIR-IMTECH and Tamil Nadu Agricultural University

Funding Agency: DBT, New Delhi

PI & Members: Dr Ratul Saikia (PI), Dr Tarun C Bora (Co-PI), Dr Prakash J Saikia (Co-PI), Mrs Archana Yadav (Co-PI)

Salient Achievements:

Isolation of Microbes: We have collected different bark, rhizospheric soil sample and leaf litters from protected forest areas of Assam like Gibbon and Nambor wildlife sanctuary. Then we have isolated 600 nos. of microbes (bacteria and fungi) from those collected sample.

Screening for enzyme activity: About 550 isolates were screened using different standard protocol against four selected enzymes (*viz.* cellulase, xylanase, pectinase and laccase). Out of these screened isolates, 40 bacterial isolates were positive for cellulase, 15 isolates were positive for xylanases and 20 isolates were for pectinase. In case of fungal isolates, 10 isolates were positive for cellulase and xylanases each, while 12 isolates were positive for laccase and 15 for pectinase (Fig. 1). Quantification of CMCase and xylanase assays were carried out as per DNS method. The bacterial isolates LCB-13 showed highest xylan hydrolysis capacity followed by LCB-23.

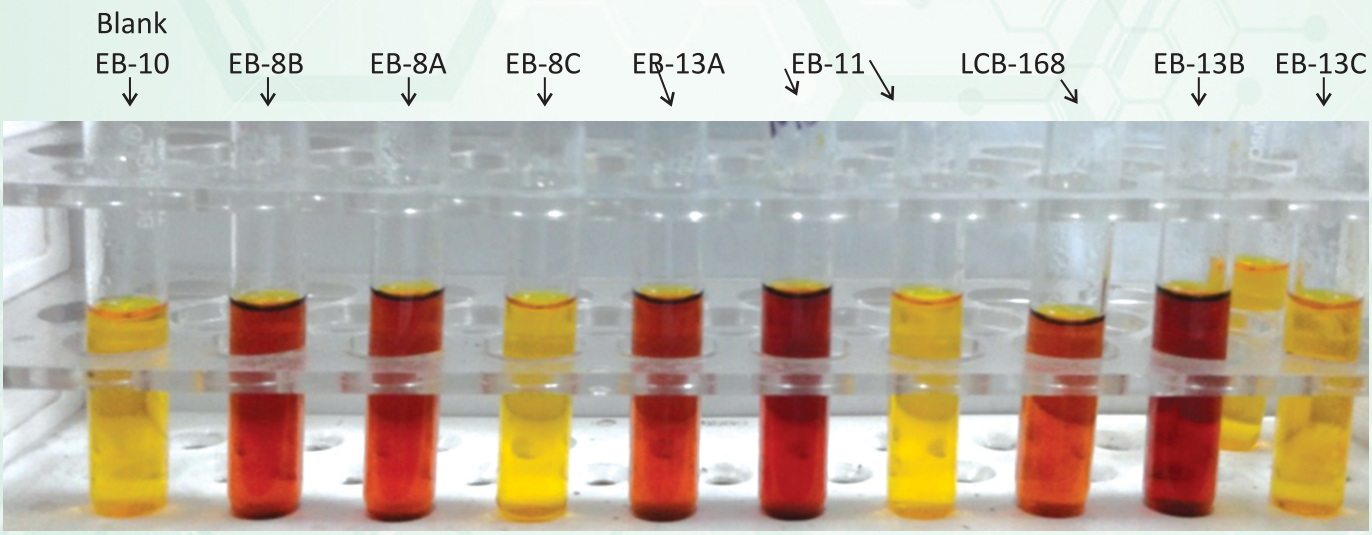
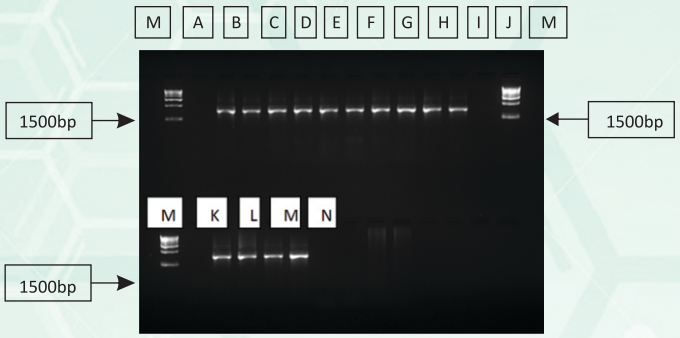


Fig. Xylanolytic assay of bacterial strains (isolated from elephant dung).

Assay for cellulose degrading enzymes: The highly potent cellulose degrading bacterial isolates were chosen for enzymatic assay and their different biochemical test. The enzymatic assay was carried out as per DNS method (Miller *et al,* 1972), 1% of substrate (CMC) conversion was measured at 540nm; and with respect to the glucose standard the concentration was measured. In addition, the potent bacterial isolates were amplified through 16S rDNA amplification for molecular identification.



M- DNA Ladder (1000bp)

Amplified PCR product [A- LCB170, B- LCB171, C- LCB172, D- NR11, E-NR16, F-NR32, G-NR33, H- M2, I- R12, J-BR17, K- LCB71A, L- LCB-72B, M- LCB75, N- LCB77]

Fig: 16S Amplification of cellulose positive bacterial strains.

Project Title: Mining the Metagenome of Bacterial in Extreme Areas of North-East India.

Project No: GPP-292

Funding Agency: ICAR, New Delhi

PI & Members: Dr Ratul Saikia (PI), Dr Tarun C Bora, Dr H P Deka Boruah, Mrs Archana Yadav

Salient Achievements:

Microbial diversity studies from traditional culture based polyphasic approach of Taxa identification were started and Illumina Miseq based metagenomics studies are currently employed. This locus of microbes was targeted to pinpoint the identity of assemblage. It can be done by generating census data either by cloning the amplified any of the variable region (V3 to V9) and segregating the target from the mixture by transforming into a bacterial host and identify individual entities by traditional Sanger sequencing or directly deep sequence reads by generated single and or paired end library. The generated libraries are then multiplexed with barcodes for increasing throughput and parallelization. *Rhododendron arboreum* is an endemic species which is vastly spread in the entire of Arunachal Pradesh. In this study, Ilumina MiSeq (2X150 bp) PE Library sequencing of 16S-V3 amplicon from some soil samples associated with *Rhododendron arboretum* of Tawang has been done (Fig). The sequences were analyzed through UPARSE and QIIME pipelines to generate of operational taxonomic unit (OUT) table and taxonomic assignment was evaluated against RDP database. Our study showed that elevational gradient influenced rhizospheric bacterial community of *Rhododendron arboreum.* From the investigation it was observed that Actnobacter were dopminant (Fig).



Fig: A sampling site at Tawang (AP).

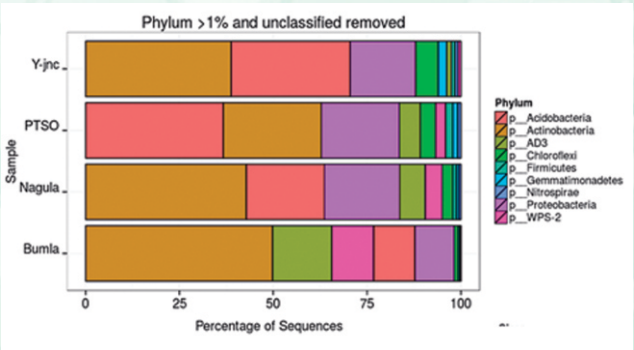


Fig: Taxonomic composition of bacterial communities (phyla) associated with four different *Rhododendron arboreum* rhizosphere sites in Tawang.

Project Title: Raising of clonal microgarden and validation of microclones of 'Assam Teak' (*Phoebe goalparensis* Hutchinson) through multilocational trials in selected areas of N. E. Region.

Project No: GPP-298

Funding Agency: DBT

PI & Members: Dr K D Mudoi (PI), Dr SP Saikia (Co-PI)

Objectives:

- Optimization of nutritional status, culture conditions for in vitro propagation/ multiplication of Phoebe goalparensis through different explants sources.

Salient Achievements:

- Mature seeds of *Phoebe goalparensis* (Fig. A) were collected from two locations of N.E. Regions (Assam & Arunachal Pradesh).
- Seed viability was tested by using 'water submergence selection process' & viable seeds were used for surface sterilization by pre-treating with 0.2% Bavistin for 30 min prior to rinse with 0.1 % $HgCl_2$ solution for 8 minutes.
- For in vitro germination, seeds were inoculated into full and half strength of MS and WPM medium with (0.1-5.0 mg/l) single or combine supplementation of BAP, kinetin & GA3. Seed germination p.c. was low (Fig. 1B-D).
- Seedlings of *P. goalparensis* were collected from Forest Deptt. Govt. of Assam and established in the field of CSIR-NEIST Experimental farm for raising of in vitro culture.
- Nodal explants and apical shoot buds of *P. goalparensis* were collected from experimental farm (Fig.1E-F). After surface sterilization (same as above) nodes or shoot tips were cultured into MS and WPM medium along with the supplementation of BAP & kinetin (0.5-5.0 mg/l).

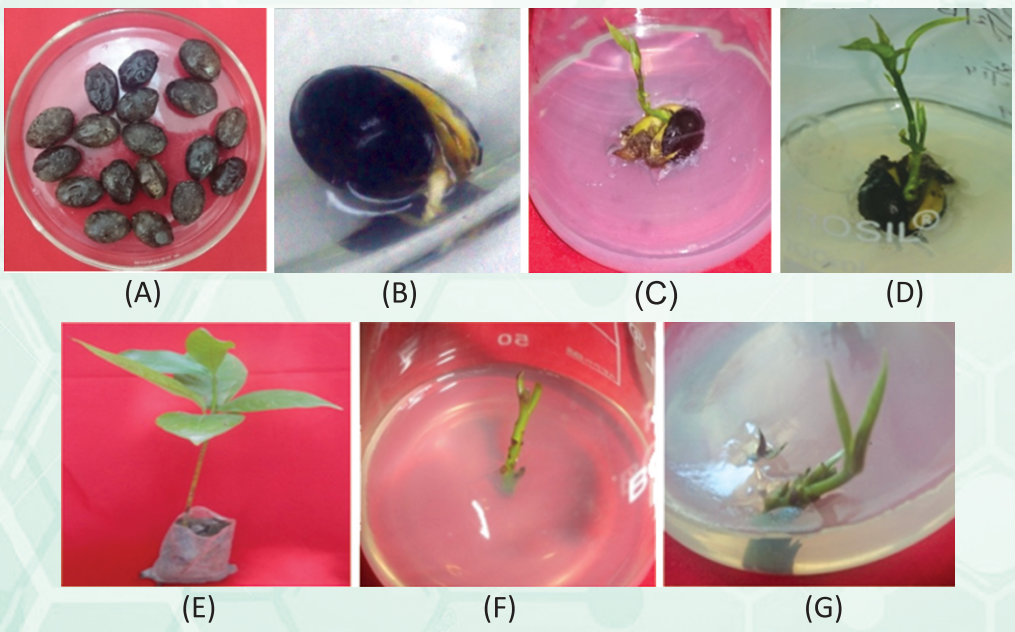


Fig: Collected seeds (A),*In vitro* seed germination (B), *in vitro* shoot regeneration (C-D), collected seedlings (E) & shoot tip culture of *Phoebe goalparensis* (F-G).

Project Title: Butterfly and plant interaction studies in NRL Butterfly Valley at Township.

Project No: CNP-468

Funding Agency: Numaligarh Refinery Ltd, Numaligarh, Golaghat

PI & Members: Dr M Bhuyan (PI)

Objectives:

- Butterfly population studies and their in-situ conservation.

Salient Achievements:

Documented 75 nectar and larval plant species in the butterfly Valley of NRL Township. Another 15 nectar and larval host plant species of butterfly have been identified to incorporate in the valley. Life cycle parameters of four butterfly species have also been documented. Basic information generated during the study period on nectar host plant range and preferences, and butterfly multiplication is very much useful for conservation of butterfly in butterfly valley. This outcome is vibrant for maintenance of butterflies in future and to develop butterfly conservation plan for butterfly valley at township.

CHEMICAL SCIENCES & TECHNOLOGY DIVISION

In Chemical Sciences & Technology Division, the thrust of the research has been focused on green approaches for development and value addition of bioactive and biopolymers. This Area consists of four divisions- Natural Products Chemistry, Medicinal Chemistry, Synthetic Organic Chemistry and Analytical Chemistry with four work packages respectively.

A) International Collaboration

Project Title: Screen Printed Electrodes (SPEs) Functionalized with Organic- Inorganic Hybrid Nano-Composites for Bio-sensing Applications.

Project No: GPP-289

Funding Agency: DST, Govt. of India, Indo-Russian Bilateral

PI & Members: Dr R Khan (PI)

Salient Achievements:

Myoglobin (Mb) is a single-chain protein of 153 amino acids containing a heme (iron-containing porphyrin) group in the centre which is found in mammalian skeleton and muscle tissues and regulates the storage and diffusion of oxygen in heart and skeletal muscles. Myoglobin plays an important role in disease diagnosis because it is a sensitive marker for muscle injury and a potential code for heart attack in patients with chest pain. In the present study, we have demonstrated a simple, immune-sensor signal amplification method to detect cardiac myoglobin using screen-printed electrode containing multiwalled carbon nanotubes. EIS studies the system response to the application of a periodic small amplitude ac signal. These measurements are carried out at different ac frequencies. Analysis of the system response contains information about the interface, its structure and reactions taking place in the system. Electrochemical impedance spectroscopy measurements show a low detection limit of ~ 0.08 $ngmL^{-1}$, with linearity and high sensitivity.

B)National Collaboration

(i)Network Projects

Project Title: Catalyst for Specialty Chemicals (CSC).

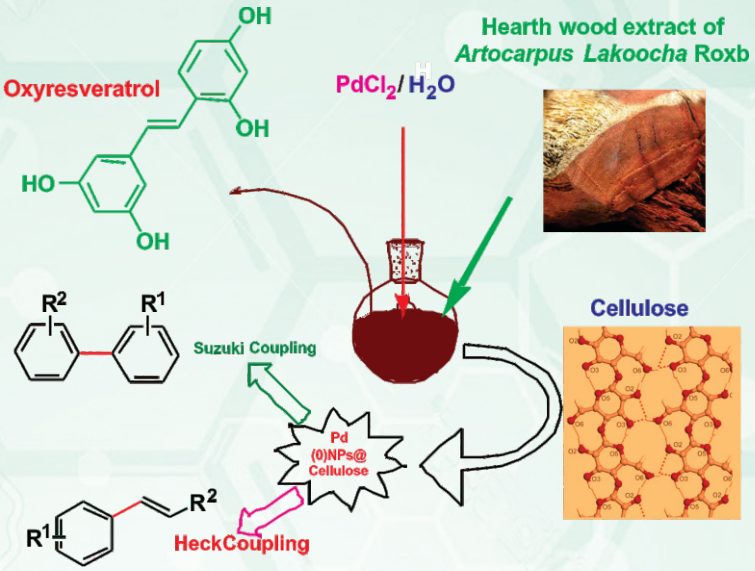
Project No: CSC-125

Funding Agency: CSIR

PI & Members: Dr Dipak Kumar Dutta (PI), Dr Dilip Konwar (Co-PI)

Salient Achievements:

- **Synthesis and study of the reactivity of cellulose supported Pd-nano particles:** A simple, convenient and green protocol has been developed for the synthesis of cellulose supported Pd(0) nanoparticles (NPs) using hearth wood extract of *Artocarpus lakoocha* Roxb. as a bio-reductant. Synthesized cellulose supported Pd(0) NPs have been used as an efficient catalyst for Suzuki and Heck coupling reactions in water under microwave irradiation. The prepared Pd(0) NPs were characterized by Ultraviolet–visible (UV–vis), Fourier transform-infrared spectroscopy (FT-IR), X-ray diffraction (XRD) and Transmission electron microscopy (TEM). The catalyst can be recycled up-to ten times without losing its activity significantly.



Project Title: Natural Products as Affordable Healthcare Agents (NaPAHA).

Project No: CSC-130

Funding Agency: CSIR, New Delhi

PI & Members: Dr M J Bordoloi (PI), Dr K G Raghu (CSIR-NIIST), Dr H V Thulasiram (CSIR-NCL), Dr Sunil Kumar (CSIR-IIP), Dr Bikram Singh (CSIR-IHBT), Dr K Sureshbabu (CSIR-IICT), Dr Ram A Meena (CSIR-CSMCRI), Dr Shashi Singh (CSIR-CCMB), Dr S S Cameotra (CSIR-IMTech)

Salient Achievements:

- Under this project, the work has been carried out targeting multiple sites of the phosphatidylinositol-3-kinase (PI3K) pathway for its optimal inhibition. Development of anti-cancer agent without side effects and toxicity is a thrust area of current scientific research. Cancer suppressive activity of the aroma component from essential oils has captivated a lot of attention which are natural, multi-component complex systems. One hundred twenty three volatile compounds found in essential oils from different plants were analyzed for their druglikeness and other parameters.

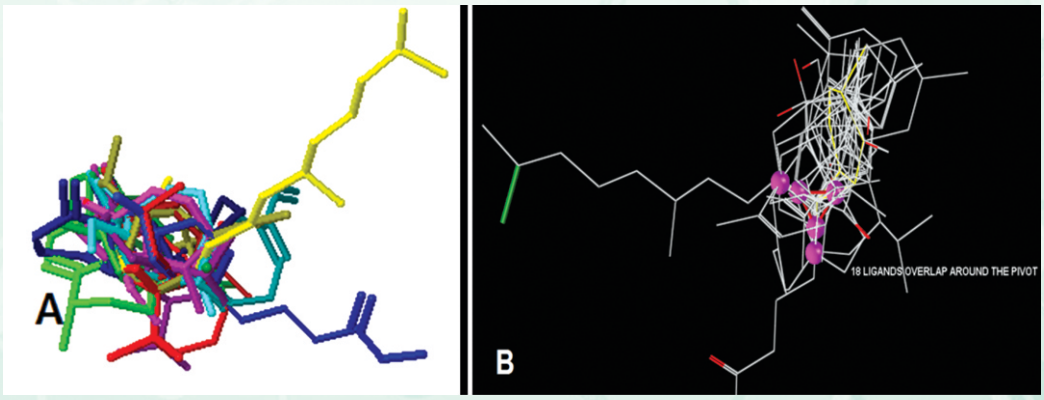


Fig: Alignment file of the twenty one best small molecules filtered for common feature pharmacophore model; B) The pharmacophore generated

- In-silico screening of anti-viral compounds, peptide designing and network construction for unveiling protein interactions of influenza virus: In this study, in silico screening of natural compounds were done against H1N1 virus and designing specific antiviral peptides for crucial viral proteins to curb viral infections were evaluated one hundred and seventy four phytochemicals from selected medicinal plants for their affinity to HA, NA,M2 channel,NS2 and PA viral proteins. In silico evaluation of antiviral peptides designed were made through protein-protein docking with crucial virus proteins and host factors were analyzed using topology and modularity analysis of host-pathogen interaction network.

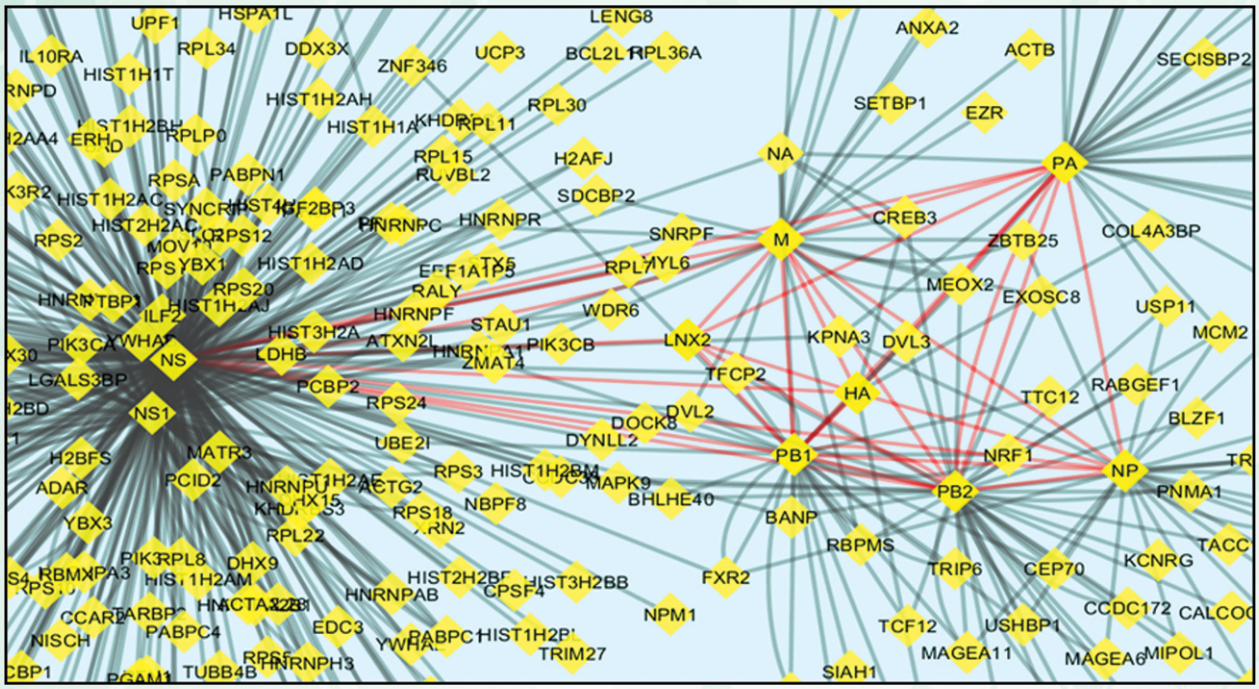


Fig: Cluster analysis (red lines) of human-H1N1 virus protein-protein interaction network

- Marine steroids as potential anticancer drug candidates: In silico investigation in search of inhibitors of Bcl-2 and CDK-4/Cyclin D1: Star fishes (Asteroidea) are rich in polar steroids with diverse structural characteristics. We undertook in silico screening of 182 natural steroids from star fishes occurring in different parts of the world and their 282 soft-derivatives against Bcl-2 and CDK-4/Cyclin D1 – two important targets of progression and proliferation of cancer cells and predicted their hysic-chemical properties, druglikeliness, binding potential with the selected targets, ADMET.

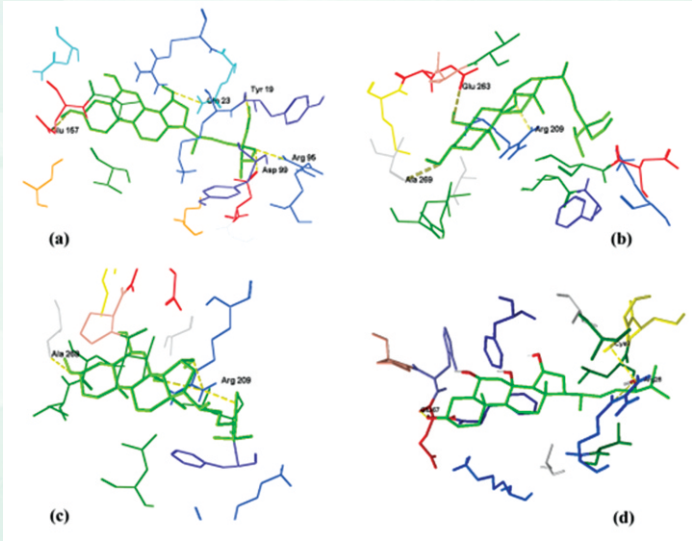


Fig: Anticancer properties studied through in silico methods