Swami Rama Himalayan University

Centre of Excellence in Plant Biotechnology

(CoEPB)

Research and Activity Report

2024-2025

About School of Biosciences

The School of Biosciences (SBS) began it journey under the umbrella of the Himalayan institute of Medical Sciences (HIMS) in 2017-18 and became independent in 2021. Over the years, three Departments emerged out of SBS, Department of Biotechnology; Department of Biochemistry and Department of Microbiology. Ph.D. and master students, both from HIMS and SBS, continued to do their research under the umbrella of these three departments. Till 2024, 18 students have completed their Ph.D. and 10 are continuing. The list along with their supervisors and areas of research is provided in the link. https://srhu.edu.in/school-of-biosciences/. Gradually with the intake of fresh faculty, the D/o Biotechnology started having its two branches, Plant Biotechnology and Animal Biotechnology. As a number of faculty members specialize in plant sciences, the Plant Biotechnology area culminated into a Centre of Excellence on Plant Biotechnology, that have been funded through seed funds and extramural grants by various agencies, UCOST, UCB, DST etc.

Plant Biotechnology Laboratory

The Plant Biotechnology Laboratory was established in 2017-18 with four faculty members specializing in plant-microbe interactions, molecular biology, tissue culture, and biochemistry. In the period between 2018 to 2024, activities which could enhance the R & D portfolio such as setting-up labs for Plant-tissue culture activities; Host-parasite relationship in Plants; enhancing commercially valuable plant products, Biofertilizers and Biocontrol agents etc. were carried out. It also included training of faculty, in-house

research activities, inducting Ph.D. students and conducting seminar/symposium, conferences etc. in areas covering plant biotechnology. During 2024-2,5 a need was felt to expand the lab into a **Centre of Excellence in Plant Biotechnology (CoEPB).** A seed grant of ₹53.00 lakh was sanctioned to various faculty around the same theme to support tissue culture research on Badri Tulsi, *Cordyceps, Rheum* sp., and *Gymnema sylvestre*. CoEPB now accommodates five faculty members, 20 postgraduate students, and 5 Ph.D. scholars.

Centre of Excellence in Plant Biotechnology (CoEPB)

Vision

To be a leading Center of Excellence in Plant Biotechnology, advancing sustainable agriculture, environment, food security, and mushroom cultivation, plant-microbe-interactions, and hydroponics, through innovative research, cutting-edge technologies, and capacity building for future generations.

Mission

1. To conduct pioneering research in the field of plant molecular biology, tissue culture, genetic engineering, and plant-microbe-interactions for Uttarakhand's medicinal, and commercially important plant improvement and resilience.
2. To develop eco-friendly and cost-effective biotechnological solutions that enhances productivity, nutritional quality, and stress tolerance in plants.
3. To conserve and utilize plant genetic resources for sustainable use, environment and biodiversity protection.
4. To foster interdisciplinary collaborations with academia, industry, and farming communities for technology transfer and commercialization.
5. To train students, researchers, and stakeholders in advanced plant biotechnology techniques, empowering them to address global agricultural and environmental challenges.

Aims

The main focus of the laboratory is to standardize protocols for plant tissue culture, microbial isolation and purification from plant samples. The focus is on the local medicinally and commercially important species such as *Rheum emodi*, *Bacopa monnieri*, *Ocimum tenuiflorum* (Badri Tulsi), *Cordyceps*, etc. Through the expansion of the plant biotechnology laboratory, the users have standardized the protocols of *Rheum emodi*, *Bacopa monnieri*, *Ocimum tenuiflorum*, and isolation of endophytes from diverse commercially important plants. Now CoE is in the process of upscaling the process through the collaboration with SRHU Innovation Center, and also exploring the possibilities with

outside organizations. The State Government has also promised an exclusive lab for the purpose of expansion of protocols for Badri Tulsi, *Cordyceps*, *Rheum* sp. and *Gymnema sylvestre*. New equipment namely, plant growth chamber, laminar air flow, shaker incubator, autoclave, weighing balance, vortex mixer, tissue culture racks, Microscope, electrophoretic units, Shaking incubator Gel documentation unit, PCR Unit, Spectrophotometer, Water bath etc. were secured through the seed funding to the group leader Prof. Vivek Kumar.

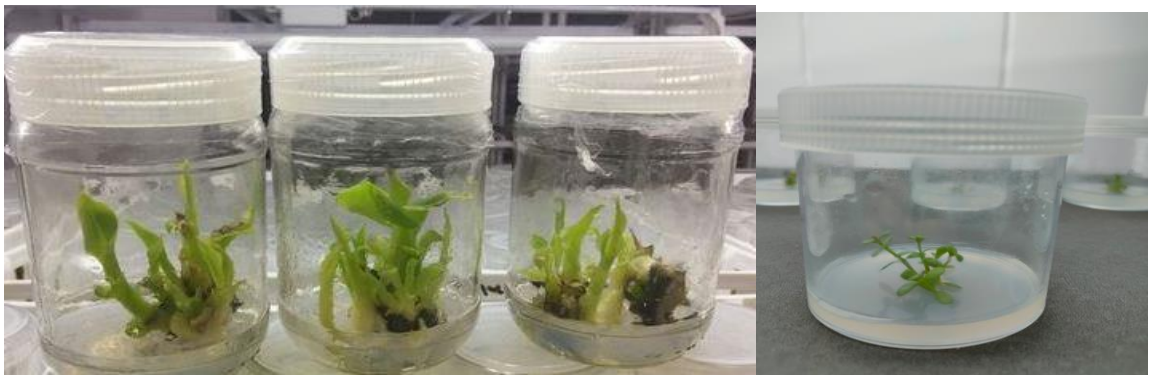
List of Seed Projects sanctioned under CoEPB during 2024-25

S No.	Name of the Project	Name of the investigator	Duration of Project	Sanctioned amount in Lakhs
01	Investigating the Potential of Fungal Mycelium Mats: Comparative Analysis of Various Fungal Species for Future Research Advancement	Dr. Nupur Joshi, Dr. Geeta Bhandari, Dr. Archna Dhasmana, Dr. Vikas Singh Jadon, Dr. Sanjay Gupta	24 Months	6.00
02	An effective microbiological growth medium for screening zinc solubilizing microbes	Dr. Vivek Kumar Dr Sanjay Gupta Dr Vijay Kumar	24 Months	6.00
03	Upgrading plant microbe-based approach to enhance phytoremediation method in contaminated water body	Dr. Vivek Kumar Dr Sanjay Gupta Dr Vijay Kumar Dr Akhilesh Kumar	24 Months	20.00
04	Metagenomics analysis of hospital waste water for determination of drug resistance genes	Dr. Vivek Kumar Dr Sanjay Gupta Dr Vijay Kumar Dr Geeta Bhandari Dr Akhilesh Kumar Dr Yogesh Saxena	12 Months	6.00
05	Elite germplasm selection based on elicited gymnemic acid and antioxidant status of Gurmar (Gymnema Sylvestre.) using micro- propagation techniques	Dr. Vikash Singh Jadon Dr Sanjay Gupta Dr Archana Dhasmana	24 Months	15.00
Total				**53.00**

A presentation was made to Governor, Uttarakhand for securing funds from the Stae Government towards tissue culture activities.

The presentation is at:
https://docs.google.com/document/d/1s7oeESRmZeM3M6qMYfcH86kXotVerRyN/edit?usp=sharing&ouid=101295203916272553402&rtpof=true&sd=true

Researcher engaged in plant tissue culture in laboratory



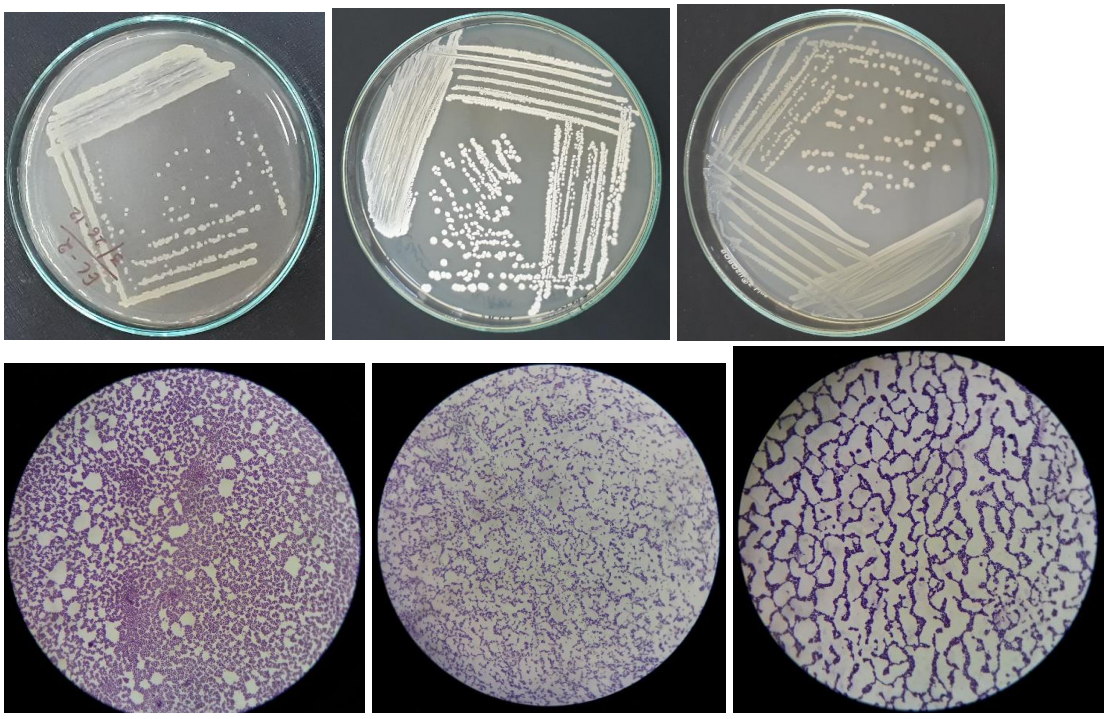
Cultivation of plants under controlled conditions

Plant-microbe-interaction research

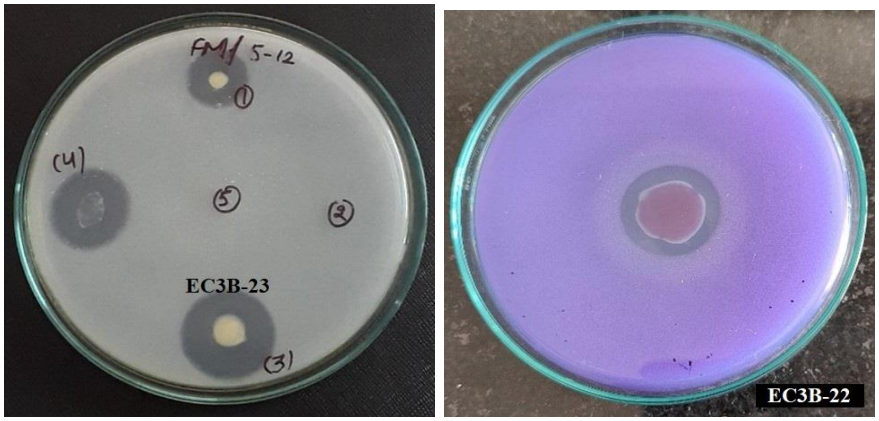
The Plant-Microbe Interaction Laboratory focuses on exploring the complex relationships between plants and beneficial microorganisms to enhance crop productivity, stress tolerance, and environmental health. Research in the lab emphasizes microbial diversity, rhizosphere ecology, biofertilizer development, and biocontrol mechanisms. Advanced molecular tools are used to understand microbial role in nutrient solubilization, and plant growth-promoting traits. The laboratory aims to harness these natural interactions for sustainable agriculture and ecosystem restoration. Through multidisciplinary approaches, it contributes to innovations in bioinoculant formulation, phytoremediation, and soil health improvement, promoting eco-friendly alternatives to chemical-based farming practices.
Dr. Kumar is also working on nutrients mobilization by microbial means. Plant–microbe interactions play a crucial role in enhancing zinc solubilization in soils, thereby improving its bioavailability to plants.

The IM project proposal entitled **"An Effective Microbiological Growth Medium for Screening Zinc Solubilizing Microbes"** aims to develop and optimize a selective and efficient culture medium to identify and quantify zinc-solubilizing microorganisms from soil and rhizosphere environments. Zinc deficiency is a widespread agricultural problem affecting crop yield and nutritional quality. Microbes capable of solubilizing insoluble zinc compounds play a vital role in enhancing zinc bioavailability to plants. However, existing media often lack precision and efficiency in differentiating strong zinc solubilizers. This project proposes to formulate a novel medium with optimized carbon and nitrogen sources, pH, and zinc substrates to improve detection sensitivity and reproducibility. The study will involve isolating microbial strains, evaluating solubilization efficiency through halo zone formation, and validating the results using quantitative assays and molecular characterization. The development of such a medium will provide a reliable tool for rapid screening of potent zinc-solubilizing microbes, facilitating their use in biofertilizer formulations. Ultimately, the project will contribute to promoting micronutrient-enriched sustainable agriculture and reducing dependence on chemical fertilizers.

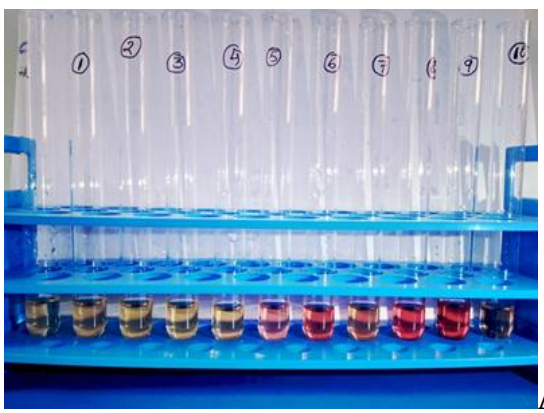
Plant-microbe-interactions Research Activity



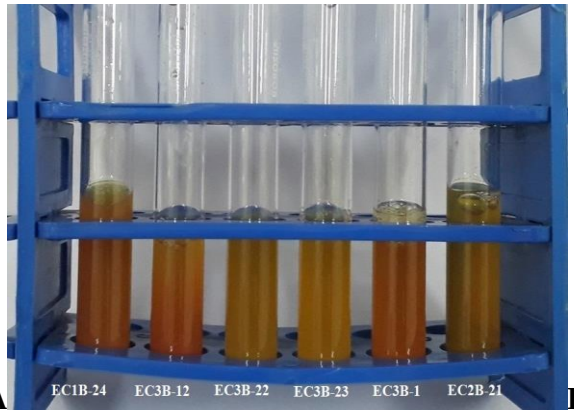
Endophytic bacteria isolated from finger millet plants



Zinc and iron solublization by bacetrial endophytes



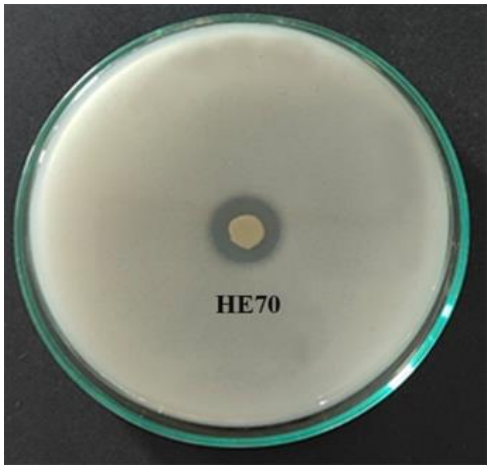
A

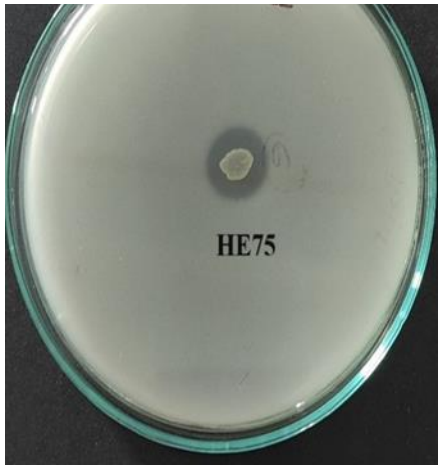


B

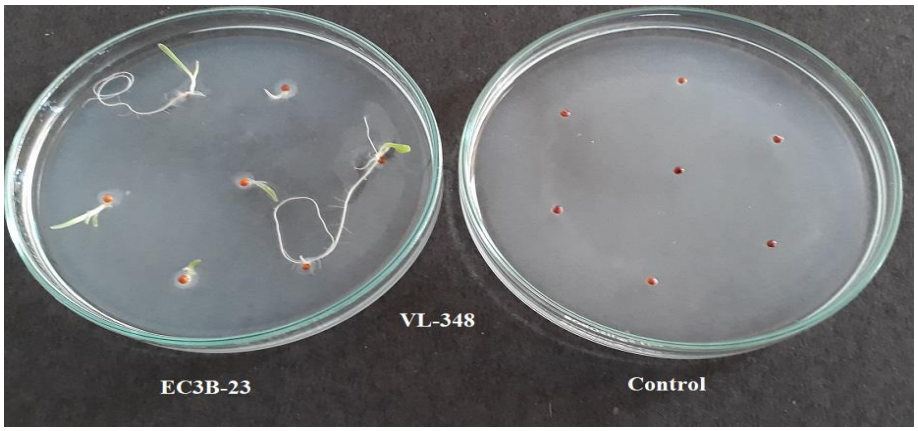
A. Indole acetic acid (IAA) biosynthesis by diverse bacterial isolates (dark pink color shows, higher amount of IAA production)

B. Ammonia production by diverse bacterial isolates





Enzyme phytsase production by bacterial isolates



Effect of biofertilizer on seed germination

Plant-environmental-microbiology Laboratory: Plant-microbe-interaction; microbe-microbe-interactions towards environmental resilience

The plant-environmental-microbiology laboratory is working towards the sustainable and green ecosystem. The project proposal entitled "Upgrading Plant Microbe-Based Approach to Enhance Phytoremediation Method in Contaminated Water Body" focuses on developing an innovative and sustainable biotechnological solution to address the growing problem of aquatic pollution. Phytoremediation, a green technology utilizing plants to remove, stabilize, or degrade contaminants, often faces limitations such as slow pollutant uptake and plant stress under high toxicity. This project aims to overcome these challenges by integrating pollutant-tolerant plants with efficient microbial partners, including plant growth-promoting rhizobacteria and endophytes, to form an enhanced plant–microbe consortium. These microbes can improve plant growth, increase nutrient uptake, and facilitate the degradation or transformation of heavy metals, pesticides, and organic pollutants through enzymatic and metabolic activities. The study will identify and characterize effective microbial strains, optimize plant–microbe combinations, and evaluate their performance in controlled and natural water systems. Advanced molecular, biochemical, and metagenomic tools will be employed to unravel the mechanisms of enhanced remediation and microbial interactions within the rhizosphere. The proposed work is expected to deliver an upgraded phytoremediation model that ensures faster, more efficient, and sustainable restoration of contaminated water bodies, contributing to environmental protection, public health, and long-term ecological balance.

Further, another project proposal sanctioned under the plant-environmental-microbiology laboratory entitled **"Metagenomic Analysis of Hospital Wastewater for Determination of Drug Resistance Genes"** aims to investigate the prevalence, diversity, and distribution of antimicrobial resistance (AMR) genes present in hospital effluents. Hospital wastewater is a critical hotspot for the accumulation and dissemination of antibiotic residues, resistant bacteria, and mobile genetic elements that contribute to the spread of multidrug resistance in the environment. Using advanced metagenomic sequencing and bioinformatic analysis, this study will profile the resistome—the complete set of resistance genes—in wastewater samples from different hospital sources. The research will identify key bacterial taxa harboring resistance genes and evaluate the potential for horizontal gene transfer to environmental microbes. Additionally, physicochemical characterization of wastewater will be conducted to correlate pollution load with AMR gene abundance. The findings will provide valuable insights into the environmental dimension of antimicrobial resistance and support the development of effective treatment strategies for hospital effluents. Ultimately, this project will contribute to mitigating the risk of environmental dissemination of drug-resistant pathogens, strengthening surveillance systems, and promoting public health safety through informed wastewater management practices.

Both the plant–microbe-based enhancement of phytoremediation in contaminated water bodies and the metagenomic analysis of hospital wastewater for drug resistance genes converge on a common goal—understanding and mitigating the environmental impact of anthropogenic pollutants. While the first approach focuses on developing sustainable biotechnological strategies to cleanse contaminated ecosystems using synergistic plant–microbe interactions, the second provides critical insights into the microbial community structure and the spread of antibiotic resistance determinants in polluted aquatic environments. Integrating findings from metagenomic analyses into phytoremediation research could enable the design of targeted bioaugmentation strategies, where specific plant-associated microbes capable of degrading contaminants or curbing resistant gene dissemination are employed. Together, these studies form a complementary framework for restoring ecological balance and reducing public health risks associated with wastewater contamination.

Growth of bacterial isolates

Other faculty members who continued and brought –in new research ideas of plant biotechnology included Dr Vikas Jadon, Dr Nupur Joshi, Dr Samiksha Joshi, and Dr Megha Sharma. To accommodate these sophisticated equipment and researchers, the laboratory space re-designed and re-furbished with new infrastructure, including restricted entry point, temperature and humidity controller and appropriate functional benches so that the research work of five faculty members and 20 PG and 5 Ph.D. students can be carried out in systematic and scientific way. The details are provided in the link at https://srhu.edu.in/school-of-biosciences/

Besides carrying out research work, the laboratory is also being utilized for teaching the UG and PG (Biotechnology, Biochemistry, and Microbiology) students. SBS is also in touch with TERI, Uttarakhand Council for Biotechnology (UCB), IHBT, Palampur and NBRI, Lucknow to procure standardized material along with the protocols. The University has recently started hiring faculty trained in hydroponics technology, who have received seed grant to setup a Hydroponic Laboratory for draft Tulsi, tomato and local fruits. SBS is following the design of research laboratory of Uttarakhand Council for Science and Technology (UCOST). The laboratory is also focusing on mushroom cultivation, and standardized the protocol for medicinal mushroom cultivation. In the field of plant-microbe-interactions, the laboratory has developed protocol to isolate endophytes. Use of endophytes has also been exploited in micronutrient biofortification of finger millet plant.