



Project Proposal for Ph.D.

| Project Details                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| Project Title                             | Safe-by-Design Nanoparticle Microbe Systems for Soil Health, Stress Resilience, and Biomedical Functional Molecule Discovery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Project Summary                           | <p>Microbes, particularly actinomycetes are central to both agricultural sustainability and biomedical innovation, renowned for their ability to produce diverse secondary metabolites ranging from phytohormones and siderophores to clinically significant antibiotics. Yet their performance in soils is often limited by environmental stresses, while their biomedical potential remains underexplored in agri-linked contexts. This project proposes the development of safe by design nanoparticle-microbial systems to simultaneously enhance soil fertility, improve plant stress resilience, and unlock new metabolite pools with biomedical applications. Engineered nanoparticles will be deployed at optimized, non-toxic concentrations to act as elicitors, stimulating actinomycete growth, nutrient cycling, and metabolite synthesis. Soil-microbe-plant assays will be integrated with metabolomics and basic bioactivity screening to evaluate both agricultural benefits (nutrient mobilization, stress tolerance) and biomedical potential (antimicrobial or anticancer activity of elicited metabolites).</p> <p>An AI-enabled resilience–toxicity framework will guide nanoparticle formulation, ensuring ecological safety while maximizing productivity. The proposed work creates a dual-impact platform: contributing to sustainable agriculture by strengthening soil-plant systems and to biomedicine through discovery of novel metabolites. Designed to be experimentally tractable and interdisciplinary, the project offers fertile ground for training young scholars, enabling high-quality publications, and laying the foundation for future translational research hubs at the agriculture–biomedicine interface.</p> |
| (Minimum 500 and maximum 2000 characters) | <p>Objectives</p> <ol style="list-style-type: none"><li>1. <b>Develop safe-by-design nanoparticle–actinomycete formulations</b> that enhance soil fertility and plant growth.</li><li>2. <b>Elicit and profile</b> actinomycetes under nanoparticle exposure using metabolomics tools.</li><li>3. <b>Evaluate plant stress resilience</b> conferred by nano-elicited functional molecules under abiotic stresses (e.g., drought, salinity).</li><li>4. <b>Screen selected functional molecules for biomedical potential</b>, including antimicrobial and anticancer activity.</li><li>5. <b>Establish AI-based resilience toxicity curves</b> to optimize formulations balancing productivity, safety, and translational potential.</li></ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

| Ph.D. Supervisors*<br>(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD) |                          |                                                                 |                                                                          |
|--------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------------|--------------------------------------------------------------------------|
| Role                                                                                             | Name of Faculty          | Academic Unit in IITD/Institute/University                      | Email ID (Official)                                                      |
| Supervisor 1*                                                                                    | Dr Kavya Dashora         | CRDT                                                            | <a href="mailto:kdashora@rdat.iitd.ac.in">kdashora@rdat.iitd.ac.in</a> ; |
| Supervisor 2                                                                                     | Prof Kashyap Kumar Dubey | School of Biotechnology, Jawaharlal Nehru University, New Delhi | kashyapdubey@mail.jnu.ac.in                                              |

\*Supervisor 1 must be from IIT, Delhi.  
 +All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.  
 \$The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

Project requirements (Student qualifications, experience required, etc)
\*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)

The candidate will be shortlisted based on Educational background:

- Master’s degree (M.Sc./M.Tech./M.S.) in Biotechnology, Microbiology, Biochemistry, Agricultural Sciences, Environmental Science, Nanotechnology, or related disciplines with CGPA 7.5 and above.
- Desirable skills:
  - Basic training in microbiology (culture handling, sterile techniques).
  - Familiarity with plant biology or soil microbiology.
  - Exposure to analytical techniques such as spectroscopy, chromatography, or molecular biology tools.
  - Interest in nanotechnology applications, plant-microbe interactions, or biomedical screening.

Experience Required (Preferred, not Mandatory)

- Experience in microbial growth assays, plant stress experiments, or metabolite/natural product extraction.
- Familiarity with simple bioassays (antimicrobial or stress tolerance).
- Basic data analysis skills; prior exposure to R/Python/AI tools is a plus but not essential.

Source of fellowship/funding and project number  
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with his/her own fellowship.

| Role of Faculty Members involved: |                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------|
| Supervisor-1                      | Experiments based on soil potential for nanoparticle -actinomycetes system          |
| Supervisor-2                      | Experiments based on the biomedical potential of nanoparticle -actinomycetes system |

- Note :-**
- Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SIRe.
  - Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SIRe student.

3. **PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.**
4. **If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.**
5. **A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.**
6. **The third supervisor's name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.**
7. **If Institute fellowship is being sought, then DRC approval of the parent department of Supervisor 1 is required at the time of selection.**