PROJECT TITLE: The hidden nitrogen factory: Microbial carbon mining to build persistent organic nitrogen in soil

Project Science Theme: Science for Environmental Solutions
Project keywords: Soils, microbiology, carbon, nitrogen, biogeochemistry

Lead Institution: University Bristol
Lead Supervisor: Professor Ian Bull, Bristol, Chemistry
Co-Supervisor: Iain Hartley, University of Exeter, Geography
Co-Supervisor: Andy Gregory, Rothamsted Research, Rothamsted Long-Term Experiments / Soil Health and Management
Co-Supervisor: Richard Evershed, University of Bristol, University of Bristol

Project enquiries: ian.d.bull@bristol.ac.uk
Webpage: https://www.bristol.ac.uk/chemistry/research/ogu/

Project description:
Society faces two linked soil challenges: increasing soil carbon stocks to help mitigate rising atmospheric CO_2, whilst reducing pollution from excessive inorganic-N fertiliser use. This project asks: how efficiently do soil microorganisms convert soil-C and fertiliser-N into persistent organic-N; how does long-term N availability alter its production, turnover and stabilisation; and can this process simultaneously enhance soil C and N storage? Answering these questions could reveal a route to improving soil fertility whilst reducing reliance on synthetic fertilisers.

The project will exploit Rothamsted Research's long-term experiments (LTEs), comparing contrasting fertiliser and organic matter regimes. Molecular and isotopic analyses in the world-leading Organic Geochemistry Unit (OGU) at Bristol, will quantify amino sugars, proteins and other microbial biomarkers, relating them to soil-C and N-cycling. Cutting-edge compound-class-specific radiocarbon approaches will explore the age and persistence of N-biopolymers, including DNA, testing whether soil DNA is predominantly recent or comprises older residual material. You will gain hands-on training in soil sampling, LTE experimentation, molecular analysis, isotope-ratio mass spectrometry, radiocarbon approaches, data science, statistical analysis, interpretation and scientific writing. Critically, you will have substantial ownership of your research, refining hypotheses, prioritising analytical approaches and developing new experiments as required. Regular supervisory meetings and annual progress reviews will provide guidance while supporting your increasingly independent decision-making.

The partnership between Bristol, Exeter and Rothamsted Research will provide complementary expertise, facilities and research environments. On-the-job training from supervisors, Rothamsted scientists and group researchers will expose you to diverse approaches in soil science, biogeochemistry and environmental analysis. Transferable skills supporting your research will be developed across the project through reflection with your supervisory team. Close links between the collaborating research teams will facilitate exchange of methods, joint interpretation, networking, and collaborative working, providing experience of interdisciplinary research and strengthening the skills required for an independent and successful environmental science career.

Useful recruitment links:

For information relating to the research project please contact the lead Supervisor via: ian.d.bull@bristol.ac.uk

Bristol NERC GW4+ DTP Prospectus:
https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

The application deadline is Thursday 7 January 2027 at 2359 GMT