PhD Project Advertisement

Project title: Investigating the impact of microplastics on the soil and gut microbiome and its cumulative effects on animal health

Project No: FBS2022-23-Kevei-rs
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Co-supervisors:

Dr. Jorge Gutierrez-Merino, School of Biosciences and Medicine, University of Surrey
Dr. Glyn Barrett, School of Biological Sciences, University of Reading
Prof Glen Gibson, Department of Food and Nutritional Sciences, University of Reading

Project description:

Plastic pollution is a global issue and rapidly emerging as a crisis for both environmental and human health. Exposure to microplastics impacts every level of the food chain with microplastics ingestion causing alteration of feeding activity, decreased food assimilation, stunted animal growth with negative impacts on fertility and reproduction. Microbiota perturbation by microplastics is an increasing concern with wider reaching impacts on the health of wildlife, livestock, and humans. Microplastics are ubiquitously found in the environment, and they actively influence microbial communities of the soil and the gut of animals. Soil microbial communities form intricate relationships with plants and soil organisms, and they are crucial for nutrient cycling and soil fertility. Perturbation of the gut microbiota by microplastics ingestion is an increasing concern with direct impacts on the health of wildlife, livestock and humans. Currently there is limited information on how microplastics interact with different microbial species and how bacteria-microplastics complexes influence animal and human health.

Project aim: to fill an important gap in understanding interactions between the environmental microplastic pollutants and microbial communities of the soil and of the gut of agriculturally important animal species and humans.

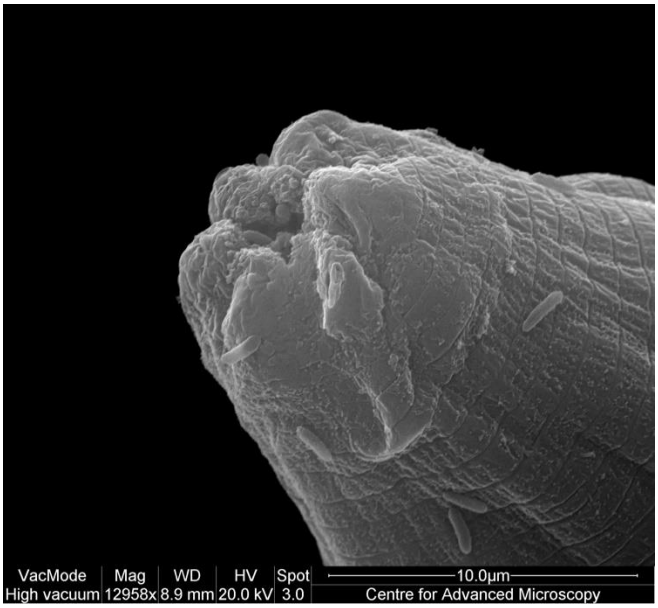

Figure 1. Scanning electron micrograph of Caenorhabditis elegans mouth with adherent bacteria. Bacteriovorous nematodes, such as C. elegans, are common residents of soil ecosystems and are critical in nutrient cycling, thereby contributing the soil fertility. Soil nematodes are important is spreading microbiota and also mineralizing the soil, while being integral part of the soil food web, consumed by predatory nematodes and insects. In the soil these nematodes can come into contact with and ingest microplastic particles which are increasingly being associated with negative impacts on animal and ecosystem health. C. elegans is an excellent model to investigate the impact of microplastics on both soil-microbiome and gut-microbiomes.

The project will use various experimental systems, including gut models and the *in vivo* nematode model *Caenorhabditis elegans*, as well as *in soil* investigation of microplastics-microbiota and soil organism interactions. The bacteria consuming *Caenorhabditis elegans* possesses a high level of conservation of tissue and cellular function and behavioural responses with higher eukaryotes including humans. Therefore, along with other in vitro models utilized in this project, it provides an advantageous model for exploring the soil and gut microbiota disturbance by microplastics. The main goal is to develop understanding how microplastics can impact the composition, dynamics, dispersal and activity of bacteria communities of microhabitats with established roles in soil fertility and animal health.

This research will contribute to fill the gaps in high-level research informed skills that are required to adopt novel, innovation-led strategies.

Training opportunities:

This is an exciting opportunity for an individual interested in studying the impact of microplastic pollution in the Agri-food sector to determine its effect on livestock and human health. The student will be exposed to different research environments by joining on this project led by four research groups (Drs Kevei, Gutierrez-Merino, Barrett and Gibson) at two locations (University of Reading and University of Surrey).

The successful applicant will experience and learn various complimentary research techniques. The student will develop a cross-disciplinary approach towards studying the adverse effects of microplastic on the terrestrial ecosystem, and the gut microbiota of animals, that form interlinked relationships within the agricultural food production. They will develop a greater understanding and gain practical skills in research methodologies of the soil bacteria and bacterivore nematode species, develop advanced molecular biology, physiology, molecular ecology and microbiological skills, with an insight to biomedical sciences. They will also learn and employ spectroscopy and microscopy methods.

The student will develop cross-disciplinary approach towards studying the adverse effects of microplastics in terrestrial ecosystem, and the gut microbiota of animals, that form interlinked relationships within the agricultural food production. The student will undergo training in *C. elegans* laboratory techniques, *in vivo* fluorescent microscopy imaging, microbiology skills and characterisation of soil structure, stability and microbiota composition. The student will be trained for the use of the *in vitro* gut model to investigate the impact of microplastics on gut microbiota. The student will have access to and learn advanced techniques in microscopy and spectroscopy, including Fourier-Transform Infrared Spectroscopy and Raman, for analysis of microplastic particles and Scanning Electron Microscopy for visualising the nematode-MP interactions. The student will also receive training in isolation and cultivation of gut microbiome bacteria strains and will learn relevant experimental techniques for the analysis on host responses upon microbiota alterations linked to disease states to develop understanding of the impact of gut microbiota on animals. The student will be trained in effective experimentation design, with a view on sound statistical principles together with efficient data collection and management. The student will have access to a range of generic skills training activities both at Reading and Surrey.

Student profile:

The project integrates the fields of molecular and cell biology, microbiology, zoology and soil science and thus would be suitable for a graduate student with a background and interest in one or more of these disciplines. The candidate must have a strong and passionate enthusiasm for scientific research and good interpersonal skills for working both responsibly and independently within a lab environment. Desirable attributes of the candidate would be strong numerical, laboratory skills in microbiology and molecular biology with good writing and oral presentation skills.

Funding particulars:

For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.