PhD Project Advertisement

Project title: Evaluating suitability of graphitic carbon from methane cracking to improve soil nutrient retention for crop uptake

Project No: FBS2024-020-Sakrabani-cq

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Georg Held, Diamond Light Source

Project description:

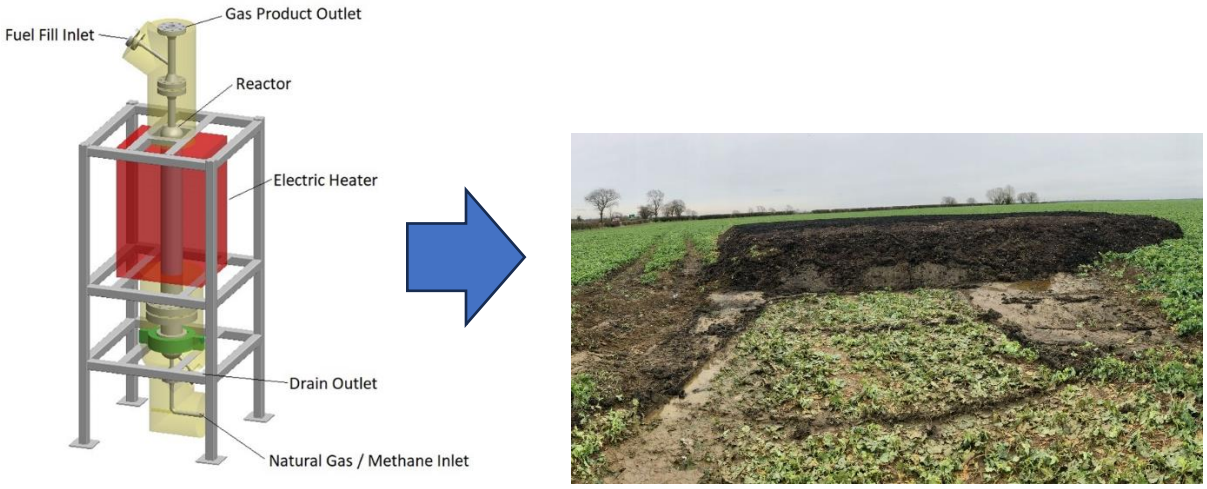
Methane is a potent greenhouse (GHG) with a half-life shorter than CO2 and can oxidise to form CO_2. Minimising methane emission by converting it to hydrogen and carbon (C) will reduce CO_2 in the atmosphere. Methane cracking offers a solution to convert methane into hydrogen and graphitic C. With the increasing concerns on declining soil health, it is pertinent to explore options to maintain or where possible increase soil carbon and this project is timely and exciting. It embraces a circular economy approach to obtain graphitic carbon from methane and assess its suitability for soils application.

This PhD project focuses only on solid C and how suitable it will be for soil applications. The C itself may be inert but its surface chemistry can be modified to act as a carrier to adsorb and alter the lability of varying nitrogen (N) sources e.g. slurry, poultry litter and urea so that it can act as a slow-release fertiliser in combination with biostimulants. With increasing mineral fertiliser prices, an opportunity to rely on an alternative source such as graphitic C as a potential renewable option in conjunction with biostimulants needs further exploration.

This project will be led by Cranfield University in collaboration with Queen's University Belfast. There will also be fantastic opportunity to use large scale facilities at the Diamond Light Source such as Synchrotron X-Ray spectroscopies. It also offers a fantastic opportunity to engage an industrial partner such as United Utilities on methane cracking and Royal Haskoning DHV which will provide supply of biostimulants. The student will be able to visit the production site in the Netherlands to have an exposure to an industrial scale operating condition. This project brings together a multi-disciplinary team comprising of soil scientists, engineers and microbiologists to tackle a challenge in a fully integrated manner.

In addition, there will also be opportunities to be trained in using specialist equipments and facilities to investigate fundamental interactions involving isotopic analysis and microbiology, to present the work in conferences and at scientific meetings both in the UK and abroad.

This project has cash contribution from United Utilities and in-kind support from Royal Haskoning DHV to provide industrial exposure on the production of biostimulant and a sponsored site visit to the Netherlands.



Methane cracking pilot plant which will produce graphitic carbon and mixed with manure to determine its suitability to establish crops

Training opportunities:

In this project there will be excellent opportunities for training on :

1. Experimental design: Theoretical and practical aspects of experimental design, microcosm and sampling

2. Laboratory analyses: Laboratory methods required for the project's analytical component, including geochemical and molecular ecology analysis for all types of samples

3. Stable-isotope probing, bioinformatics and “big data” analysis : next-generation sequence analysis with interpretation on the microbial eco-physiology in relation to environmental parameters. This also includes modelling approaches to incorporate bio-physical-chemical data to understand impact on soil health.

4. Exposure to research environment of a large-scale facility such as Diamond Light Source to use X-rays for chemical analysis and advanced data analysis

5. Transferable skills: Training in core scientific skills will be provided through the DTP courses and regular group meetings that includes scientific presentation, time and project management, team-working and communication.

There will also be opportunities to be trained on using AAS, ICP-MS for heavy metal analysis, Elementar for carbon, segmental flow analyser for nitrate and spectrophotometer for phosphorus analysis. The student will also attend MSc modules in soil science, plant genetics and food quality, if required.

Student profile:

Applicants should hold a minimum of a UK Honours Degree at 2:1 level or equivalent in subjects such as Soil Science, Environmental Science, Plant Science, Agronomy, Geography or Chemistry.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this is £18,622 and it will increase slightly each year at rate set by UKRI.

Equality Diversity and Inclusion:

The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website.

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

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