PhD Project Advertisement

Project title: Editing out insecticide use: Use of gene editing in *Eruca sativa* for more effective biofumigation
Project No: FBS2024-092-Chadwick-ra

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Project description:

Biofumigation is a means of lowering pesticide use to treat soil-bourne pests which damage crops. This project aims to improve the effectiveness of existing biofumigants to make them a viable alternative to chemicals. Biofumigation relies on insecticidal plants being incorporated into the soil, which is more sustainable, effective at protecting the soil, and incorporates other nutrients into the soil.

Insecticides are typically the most harmful crop treatment to mammals and birds, and the environment in general. Consumers who want safe to eat food, have a lower environmental footprint, or move toward regenerative agriculture may see a reduction in insecticide application as a step toward those goals. Insecticide use is also a concern to farmers who do not want to contaminate the land on which they work and live, and for the farm workers who handle insecticides in their work, for whom it is a safety concern. Pesticides in general are costly, have a notable carbon footprint, and viable alternatives to these benefit all stakeholders.

An alternative to chemical sprays and soil treatments is to apply biofumigants to ‘clean’ the soil, killing nematode worms, bacteria and insects which damage crops in a more regenerative system. Biofumigants belonging to the Brassica plant family store short lived natural chemicals in a way that is released only when the pest is present. This leads to a longer lasting, more specific and less harmful means of protecting crops. At present, downsides to this are that biofumigants are not always as effective, and can be more expensive than conventional pesticides.

This project plans to use gene editing to develop an improved biofumigant.

The first stage in the process is to identify species and varieties which work well with existing gene editing techniques and adapting these techniques for our varieties. Then, by knocking out specific genes related to the compounds of interest you will identify genetic regulators of glucosinolates and isothiocyanates, the active components in biofumigation, allowing us to better understand the biology behind their production. You will analyse the chemical composition of the original and edited plants to identify breeding targets for future commercial use. You will also investigate what other effects occur if these genes are made non-functional, as there are sometimes unexpected or ‘pleiotropic’ effects. You will grow plants under controlled conditions at Aberystwyth and Reading to ensure that the new varieties are reliable in their composition, and reliable biofumigants.

Because earlier this year this technology was approved for commercial use in the UK, with the 'precision breeding bill' this technology will be at the forefront of UK agriculture to solve many practical problems. That the skills learnt here will be particularly valuable to career prospects of the student, as gene editing is expected to be a relevant expanding sector in modern agriculture. Reduction of inputs and a move to regenerative agriculture is also an expanding area with many career opportunities.

The project draws in the unique skill bases of experts at Aberystwyth University and The University of Reading, and consequently the successful applicant would work for periods at each university starting with Aberystwyth. This will allow the applicant extended access to both skill bases without excessive travel between sites.

Training opportunities:

You will be given training in a wide range of techniques. The project involves bioinformatics, molecular cloning, plant transformation and tissue culture, field trials and plant husbandry, as well as chemical analysis work.

The project will also include statistical and computational methods including training in using R to extract complex data, and develop statistical models.

You will be offered training provided by the BBSRC: e.g. 'Personal Development', Data Analysis', 'ETP FOOD ESOP'. You will have access to bespoke training programs offered for both the University of Reading and Aberystwyth University. You will access Food DTP Summer schools throughout the PhD. By attending BBSRC dissemination events and workshops and later, international conferences you will develop your network and communicate research, while being part of an interdisciplinary PhD community

Uniquely the this project offers the potential to spend at least one year at each university, and will have full access to their in house training programs, for example UoR offers courses through the Reading Researcher Development Program: e.g. 'Ethics in research', 'How to get published'. You will have opportunities to demonstrate and support teaching of undergraduate modules if this is of interest to your career development.

Student profile:

The successful student should have an interest in agricultural sciences and genetics. The project incorporates different skills sets and would suit someone with a plant science/ biology/ genetics/ biochemistry background, but a stronger emphasis is placed on desire and ability to learn new skills than specific undergraduate qualifications.

It should be noted that the student would ideally spend the first year at Aberystwyth, and at least the final year at The University of Reading, with flexibility around the student's own circumstances for the remainder, because each university has skills and facilities not available to the other.

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.