PhD Project Advertisement

Project title: Editing out insecticide use: Use of gene editing Eruca sativa for more effective biofumigation
Project No: FBS2023-09-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.

Insecticides are typically the most harmful crop treatment to mammals and birds, and to the environment. Consumers who want safe to eat food, and a lower environmental footprint want to see a reduction in insecticide application. It is also a concern to farmers who do not want to contaminate the land on which they work and live, and for the applicators for whom it is a safety concern. Pesticides in general are costly, have a notable carbon footprint, and viable alternatives benefit all stakeholders.

Of all the treatments, soil treatments are especially difficult, as the soil can harbour nematode worms, insects, bacteria, fungi, and plant viruses, but cannot be easily treated to any depth due to the scale at which pesticides would have to be applied. The current solution is usually to use very long lasting chemical treatments on the seeds, which causes long term harm to the environment, and does not improve the soil health.

An alternative method is to apply biofumigants to 'clean' the soil, killing nematode worms, bacteria and insects which damage crops. Biofumigation relies on more sustainable insecticidal plants being incorporated into the soil, , effective at protecting and nourishing the soil. 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, yet more specific and less harmful means of protecting crops.

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 the existing protocols, and if needed adapt these protocols. This in itself is a novel step forward to researching these crops. Then, by knocking out specific genes related to the compounds of interest, we will identify genetic regulation of glucosinolates and isothiocyanates (the active biofumigant components) allowing us to understand the biology behind their production in greater detail. We will analyse the chemical composition of the wild type and the edited plants to identify breeding targets for future commercial use. We will also investigate what other effects occur if these genes are made non-functional, as there are sometimes unexpected or 'pleiotropic' effects. We will grow plants under controlled conditions at Aberystwyth and Reading to ensure that the new varieties are reliable in their composition, and their ability to act as biofumigants.

Because there is currently a bill passing the UK parliament to legalise this form of gene editing for commercial use, we anticipate that 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, if the bill is passed.

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:

As a direct part of the program, the student 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 for developing models, training in using R to extract complex data, and develop statistical models using PLS, PCA and others as the project develops.

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 course.

It should be noted that the student would be expected to spend the first year at Aberystwyth, and at least the final two years 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 2022/23 this will be £17,668 and this 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.

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