

# PhD Opportunity

## Bidirectional mobile sRNA signalling in pea-downy mildew interactions

### Supervisory team

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### Research Group

[Molecular Plant and Microbial Biosciences Research Unit \(MPMB-RU\)](#)

### The PhD Opportunity

Plants are constantly being challenged by microbial pathogens and they have evolved the capacity to detect and defend against these incoming microbes. To do this, plants use surveillance systems that are made up of extracellular and intracellular receptors and a global defence network including signaling cascades, pathogenesis related proteins and non-coding RNAs.

To overcome plant immune systems, bacteria, filamentous fungi and oomycetes secrete effector proteins that are delivered into host cells. Until now, numerous effectors have been characterized, and the current consensus is that effectors can target different cellular structures and compartments, and re-program various cellular machineries for the benefit of pathogens in terms of establishing successful infection.

Gene silencing is a cellular regulatory mechanism, and it also acts as an innate plant immune defense against pathogens. Gene silencing can be triggered by miRNA or siRNA. Gene silencing has also been exploited and used to investigate plant immune system. However, majority of the works on the pathogen side have concentrated on the effectors. In addition, some of the most important plant pathogens including downy mildews, powdery mildews and rusts are biotrophic and hence prove difficult to be transformed.

To overcome this, generally host plants are transformed with the RNAi and the gene in the pathogen that is expected to be silenced, a technique called Host Induced Gene Silencing (HIGS). HIGS may involve bidirectional movement of small RNAs (sRNA), and indeed such bidirectional sRNA movement from pathogen to host or vice versa has been investigated in several pathogen-plant pathosystems, but downy mildews are underrepresented in these studies.

We would like to investigate bidirectional sRNA movement between *Peronospora viciae* f.sp *pisi* (*PVP*) and pea plant. Reference genome sequences for both the pathogen and the host are available. This will allow a timely investigation into the role of sRNAs in reciprocal signaling between the host and the pathogen.

**Our aim and objectives are:**

1. Isolate sRNAs from *PVP* spores, infected and uninfected plant materials.
2. Carry out deep sequencing to reveal sRNAs of plant and pathogen origin.
3. Filter and align the host and pathogen sRNA complements to their respective reference genomes.
4. Determine whether any of *PVP* sRNAs are involved in pathogenicity.
5. Design further experiments to determine systemic spread of *PVP* sRNAs in infected pea plants?
6. Use RNA silencing technology to reveal the role of some of these sRNAs.

Initially, this work will determine whether the sRNAs are involved in the *PVP*-pea interactions. This would lead to; a) understanding the role of reciprocal sRNA signaling in plant-microbe interactions; b) further works to explore sRNAs in manipulating disease development using synthetic biology.

The student will receive research training in: Molecular biology, plant pathology, bioinformatics. The student will have opportunity to work with different groups and laboratories. The supervisors have extensive experience in supervising students and collaborated and published joint papers before. Results obtained from this work will be published in internationally peer-reviewed journals and will be presented at national and international scientific meetings.

**Application Process**

To begin the application process please go to <https://www.worc.ac.uk/research/research-degrees/applying-for-a-phd/>.

**The Interview**

All successful applicants will be offered an interview with the proposed Supervisory Team. You will be contacted by a member of the Doctoral School Team to find a suitable date. Interviews can be conducted in person or over Microsoft Teams.

**Funding your PhD**

For information about Doctoral Loans please visit: <https://www.worc.ac.uk/study/fees-and-finance/doctoral-loans.aspx>

During your PhD you can access the Research Conference Support Scheme to support the costs of presenting your research at an external conference.

**Research at the University of Worcester**

Research is central to the University's mission to make a difference in everything that we do. We are committed to delivering excellent research which extends the boundaries of human knowledge but which also improves people's lives by enabling

better health outcomes, improving food security, developing environmentally sustainable solutions for crop production and socially sustainable solutions to our ageing population, enhancing public knowledge and understanding of the past and present.

The University hence focuses its research around five high-level challenges facing society, locally, nationally and globally:

- [Human Health and Wellbeing](#)
- [Sustainable Futures](#)
- [Digital Innovation](#)
- [Culture, Identity and Social Exclusion](#)
- [Professional Education](#)

The success of our research is reflected in our continuous improvement in external research assessment processes. In the most recent Research Excellence Framework, REF 2021, the University saw a near 50% increase in the scale of its research and 12% increase in quality, building on its performance in REF 2014 when it was the UK's most improved university in terms of Research Power, a combination of scale and quality.

### **Research Degrees at Worcester**

Our research students are central to our overall mission for research. They are working at the cutting edge of their disciplines and driving forward the quality of our research whilst enriching our research culture. We are looking to increase our research student numbers as a strategic imperative.

Our commitment to our students is reflected in the results of the Postgraduate Research Experience Survey 2023 in which we ranked 3<sup>rd</sup> for overall research student satisfaction nationally. Key to our success in this area is the Doctoral School, a focal point for all our research students.

It provides:

- day-to-day support for our students, both administrative and practical, through our dedicated team
- a Research Student Study Space with both PCs and laptop docking station
- a comprehensive Researcher Development Programme for students and their supervisors
- a programme of student-led conferences and seminars

### **Research Group**

#### **Molecular Plant and Microbial Biosciences Research Unit**

We carry out both fundamental and translational research in the field of plant and microbial biosciences. We are interested in answering the following fundamental questions; how do obligate pathogens such as downy mildews coordinate their attack to overcome the plants' defence? What is the basis of their host specificity? Do they synchronize their physiological and metabolic activity with their hosts? Can we carry out reverse genetics to reveal the role of pathogenicity and developmental genes?

We aim to take the information gained to develop a potential disease control strategy against downy mildews on crop plants. Our further translational research includes genomic assisted plant breeding and genome editing for crop improvements.

**Widening Participation:**

As part of its mission statement the University is committed to widening participation for its higher degrees. Although most candidates will have an undergraduate and/or a Masters degree, the University is happy to accept applications from candidates with relevant professional qualifications and work related experience.

**For further information** or an informal discussion on this project, please contact Prof Mahmut Tor (Director of Studies) via email at [m.tor@worc.ac.uk](mailto:m.tor@worc.ac.uk)

