



PhD Studentship

Ecologically intensifying UK vineyards to enhance their sustainability

Closing date: 3rd May 2023

Interview date: 24th May 2023

Start date: 2nd October 2023

Supervisory team

Director of Studies:

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Supervisors:

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The Project

Applications are invited for this full-time PhD studentship, which is fully funded by the Perry Foundation, University of Worcester, Everflyht, and the Bumblebee Conservation Trust.

Context

We are amid climate and biodiversity emergencies exacerbated by the need to produce more food to feed a growing population. As part of the approach towards the sustainable production of food, UK agriculture is aiming to achieve net zero farming by 2040. Whilst this is a challenging target, it presents numerous opportunities for farmers to not only directly reduce greenhouse gas emissions but engage with actions that will result in greater carbon storage, reduce their reliance

on Plant Protection Products (PPPs), and benefit wider biodiversity. There is clearly an urgent need to develop more sustainable and therefore more resilient approaches to food production in the UK.

Wine production in the UK has increased exponentially in recent years which has been coupled with more land being used for grape growing. Importantly, the demand for UK wine is expected to increase further, from 5.9 million bottles being produced in 2018 to 40 million by 2040. We are therefore at a pivotal time for this agricultural sector with regards to its environmental sustainability.

Currently, vineyards require the intensive use of Plant Protection Products (PPPs) to control fungal disease (mildews and grey moulds) and insect pests. The use of such products has implications for human health, biodiversity, and the environment. Due to the ongoing concerns surrounding the direct and indirect impacts of PPPs, there is increasing pressure on growers to reduce their reliance on chemicals, especially as products continue to be withdrawn. In vineyards, an additional control of pests and fungal disease is achieved through the regular cutting of alleyways to keep vegetation short, however this approach also impacts biodiversity above and below the ground and limits the amount of carbon stored in the soil.

Grape growers need to future-proof production by not only having a greater reliance on alternative pest and disease management strategies, but also strategies to capture and store more carbon in the soil. To date, viticulture research in the UK has focused primarily on approaches to maximise the quality and quantity of grapes being produced. We now need research that will take the industry forward with regards to its environmental sustainability. Therefore, as part of a sustainable production system, robust evidence is needed on how grape growers can reduce their reliance on PPPs, support biodiversity, and capture and store more carbon in the soil. A blueprint for the management of UK vineyards is essential if the sector is to proceed with excellent environmental credentials whilst expanding exponentially.

The ecological intensification of cropped areas by deploying wildflower interventions has been shown to deliver a range of benefits for production in a range of crop types but is yet to be fully investigated in UK vineyards. The conventional practice of regularly mowing vineyard alleyways serves to minimise interactions between grape vines and other plants growing on the vineyard floor, and in doing so eliminates the opportunity for growers to work with nature. Research is therefore needed on how habitat interventions in vineyard alleyways can support grape production and boost the environmental sustainability of the sector.

By increasing the plant diversity of vineyard alleyways, the diversity and abundance of Arbuscular Mycorrhizal Fungi (AMF) is also likely to be increased (van Geel et al. 2015). AMF are deemed essential for the healthy functioning of terrestrial ecosystems as they facilitate nutrient cycling and the supply of nutrients and water directly to colonised plants (Trouvelot et al., 2015). Mycelial connections with grape vines are also expected to increase tolerance to biotic and abiotic stresses (Turrini et al. 2017), including water stress (Auge 2004) and disease (Berdeni et al. 2018). Enhancing the abundance and diversity of AMF in cropped areas is therefore deemed an important factor towards ecological intensification (Zhang et al. 2019).

Globally, there has been much research in vineyards, but this has been in regions experiencing different pest and disease issues under very different climates. Whilst such research is important for UK growers, our growers need access to research that has been conducted in UK vineyards. There are currently 3,800 hectares of vineyards in the UK that would directly benefit from this research, and due to the expected increase in land being used for grape growing in the UK, we are at a pivotal time with regards to its environmental sustainability.

Aims and Objectives

Over a three-year period, the key aim of this study is to investigate the potential for UK grape growers to reduce their reliance on Plant Protection Products (PPPs), support biodiversity and boost carbon capture and storage. The overall objective is to develop a more resilient and sustainable approach to grape production in the UK.

The key objectives are to:

- 1) Determine the efficacy of wildflower habitat interventions to support **natural enemies** in UK vineyards for the control of a range of key pests of grape vines.
- 2) Determine the role of wildflower habitat interventions to improve **soil health** with regards to the abundance and diversity of **Arbuscular Mycorrhizal Fungi** (AMF) and soil biota (e.g., earthworms).
- 3) Investigate the influence of wildflower habitat interventions on the relationship between **soil health** (AMF biomass) and **vine health**.
- 4) Determine the potential for wildflower habitat interventions to increase **soil carbon storage** in the alleyways of UK vineyards, and their contribution to net zero farming.
- 5) Investigate the role of wildflower habitat interventions in supporting **wider indicators of biodiversity** in UK vineyards.

Indicative methodology

The study will be undertaken in partnership with UK grape growers, ensuring research outcomes are relevant and impactful for the sector. Responses will be investigated at several vineyard sites in south-east England. At each site conventionally managed alleyways will be compared with those receiving wildflower habitat interventions. Data on the following aspects will be collected during the three-year study:

- Natural enemies
- Pest regulation services
- Pests and fruit damage
- Soil health
- Soil carbon storage
- Vine health
- Biodiversity indicators
- Plant communities

References

Auge, R.M. (2004) Arbuscular mycorrhizae and soil/plant water relations. *Canadian Journal of Soil Science*, 84, 373-381.

Berdeni, D., Cotton, T.E.A., Daniell, T.J., Bidartondo, M.I., Cameron, D.D. & Evans, K.L. (2018) The effects of arbuscular mycorrhizal fungal colonisation on nutrient status, growth, productivity, and canker resistance of apple (*Malus pumila*). *Frontiers in Microbiology*, 9.

Trouvelot, S., Bonneau, L., Redecker, D., van Tuinen, D., Adrian, M. & Wipf, D. (2015) Arbuscular mycorrhiza symbiosis in viticulture: a review. *Agronomy for Sustainable Development*, 35, 1449-1467.

- Turrini, A., Agnolucci, M., Palla, M., Tome, E., Tagliavini, M., Scandellari, F. & Giovannetti, M. (2017) Species diversity and community composition of native arbuscular mycorrhizal fungi in apple roots are affected by site and orchard management. *Applied Soil Ecology*, 116, 42-54.
- van Geel, M., Ceustermans, A., van Hemelrijck, W., Lievens, B. & Honnay, O. (2015) Decrease in diversity and changes in community composition of arbuscular mycorrhizal fungi in roots of apple trees with increasing orchard management intensity across a regional scale. *Molecular Ecology*, 24, 941-952.
- Zhang, S.J., Lehmann, A., Zheng, W.S., You, Z.Y. & Rillig, M.C. (2019) Arbuscular mycorrhizal fungi increase grain yields: a meta-analysis. *New Phytologist*, 222, 543-555.

Details of the studentship

The studentship is offered for a 4-year period on a full-time basis starting in October 2023. The studentship is campus based, but the project will involve extensive travel from the University of Worcester to field sites in south-east England. During the period of your studentship, you will receive the following:

- a tax-free bursary of £17,668 for 3 years.
- a fee-waiver for 4 years (expectation that full-time students complete in 3 years. If you enter year 4, the bursary stops but fees are waived).
- a budget to support your direct project costs including dissemination costs.
- a laptop and other IT equipment and software as appropriate to the project.
- use of the Research School facilities.

You will be expected to play an active role in the life of both the Research School and of your academic School. You will be given opportunities to gain experience in learning and teaching within the School under the guidance of your Director of Studies.

Application Process

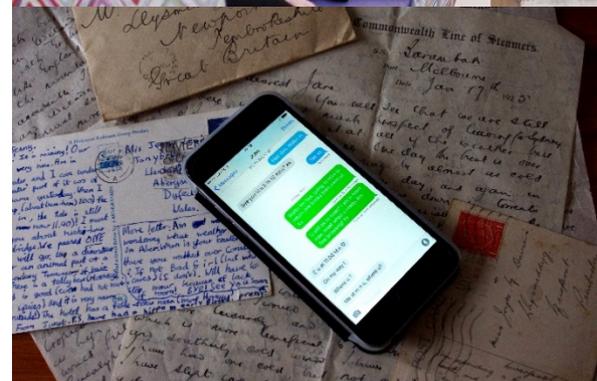
To begin the application process for this studentship please go <http://www.worcester.ac.uk/researchstudentships> and click 'apply now' next to the project you wish to apply for. It is expected that applicants will have the following qualifications / experience:

- A Masters degree in a relevant discipline e.g., ecology, entomology, soil science, environmental science, biodiversity & conservation, or equivalent professional experience.
- A First or Upper Second (2.1) Honours Degree.
- Ability to contribute to the research design of the project.
- Experience of relevant research methods and skills.
- Experience of identifying invertebrates using identification keys.
- Experience of soil sampling and lab analysis.

It is also expected that applicants will be able to demonstrate the following:

- Ability to identify common grassland plant species.
- A sound understanding of and interest in both the project and the wider subject area.
- Proficiency in oral and written English.
- Computer literacy.
- Ability to organise and meet deadlines.
- Good interpersonal skills.
- Ability to work independently and as part of a team.

In your application please ensure you clearly outline any evidence that demonstrates how you meet the qualifications / experiences expected of applicants as noted above.



The Interview

In person interviews will provisionally be held on **24th May 2023**. Shortlisted candidates will be given at least 7 day's-notice. In advance of the interview, shortlisted candidates will be asked to submit a sample of their written work (e.g. a publication or a dissertation). Alongside the interview, shortlisted candidates will also be asked to give a 15-minute presentation on a piece of research they have previously undertaken (10 mins) and their ideas for the PhD (5 mins). The presentation slides must be emailed to the Research School by 22nd May 2023. The formal interview will last approximately 40 minutes. In addition to the formal interview, shortlisted candidates will also be tested on their ability to identify a range of UK invertebrates with a focus on natural enemies of crop pests and pollinators; they will also be tested on their ability to identify some common British wildflower plant species.



Research at the University of Worcester

Research at the University of Worcester has grown significantly over the last 10 years. The outcomes of the Research Excellence Framework 2014 (REF 2014) showed that Worcester was the most improved University in the UK based on Research Fortnight's "Research Power" measure. The University's continued progress was shown in the outcomes of REF 2021 which demonstrated that both the scale and quality of our research has further increased, with over 40% of our research recognised as world-leading or internationally excellent.

The University has been successful in winning funding from a wide range of major funders: Research Councils such as AHRC, BBSRC, ESRC and NERC; major charities such as the Leverhulme Trust, the Alzheimer's Society and the British Academy; health-research funders such as the NIHR, the Department of Health and local NHS Trusts; European funding through Horizon 2020 and Erasmus+; and funding from local, national and global businesses.

The University is focused on research which addresses real world challenges and provides solutions to these challenges:

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

The University continues to provide a robust infrastructure for research. It has a well-established Research School which houses its growing research student body and which provides a comprehensive programme of researcher development for staff and students. It also has a well-

established Research Office, responsible for research funding, governance and strategy. The University is committed to further developing its research profile, through a strategic approach to its support for and investment in research. This fully funded studentship is part of this investment.

Research School

The Research School is 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.

School of Science and the Environment

Research and Knowledge Exchange within the School of Science and Environment is at the core of what we do, ensuring society benefits from our translational and applied research, and that our undergraduate students benefit from research informed teaching. The [Degree Courses](#) we deliver and the knowledge exchange we undertake therefore embody the range and reach of our impactful research.

Research within the school focuses on 'Sustainable Futures' and 'Human Health and Wellbeing'; Areas of Challenge outlined in the University's Research and Knowledge Exchange Strategy (2020-2025). We also actively engage in other research areas and encourage blue skies thinking.

To ensure the continued delivery of high quality and impactful research at the University of Worcester we have invested significantly over the last decade to enhance our research facilities. Find out more [here](#).

The successful applicant for this studentship will become a member of the [Sustainable Environments Research Group](#) (SERG). This group brings together colleagues whose research benefits people and the planet. 'Sustainable Environments' encapsulates any situation where there is potential for environmental impacts to be mitigated and for environmental benefits to be achieved. Research is across five thematic areas: 1) Food security, 2) Sustainable livelihoods, 3) River Science and Uncrewed Aerial Vehicle surveys, 4) Conservation and management of habitats and species, and 5) Sustainable places. The current PhD opportunity which investigates measures to enhance the environmental sustainability of UK vineyards builds on previous successes working in apple, sweet cherry, and orange orchards.

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 Dr Duncan Westbury (Director of Studies) via email (d.westbury@worc.ac.uk).

Applications can be made at:

<http://www.worcester.ac.uk/researchstudentships>