Project Title	Pesticide degradation in river ecosystems in a changing climate
University (where student will register)	University of Warwick
If other	Proposal submitted at Syngenta to uplift to a CASE studentship (decision known by January 2023) – this would require a minimum 3-month placement at Syngenta
Theme (Max. 2 selections)	Climate & Environmental Sustainability ☒ Organisms & Ecosystems ☐ Dynamic Earth ☐
Key words	Pesticide degradation, climate change, river ecosystems, fate and transformation, temperature
Supervisory team (including institution & email address	**PI:** Professor Gary Bending, University of Warwick gary.bending@warwick.ac.uk **Co-I** Professor Hendrik Schafer, University of Warwick h.schaefer@warwick.ac.uk **Co-I:** Dr Rebecca Southwell, Syngenta Rebecca.Southwell@syngenta.com

Project Highlights:

- Pesticides are vital for their role in food security, but thorough regulatory testing is required to ensure they are safe for both human health and the environment.
- Regulatory tests are strict in their design and not always environmentally realistic. In this project you will investigate how pesticide degradation in rivers will be altered in a changing climate, with a focus on temperature effects on persistence.
- You will use a wide range of modern chemical and molecular ecological analyses and techniques in combination with bioinformatics, to gain a broad overview of pesticide regulatory regimes.

Overview: *Maximum 350 words*

Pesticides are essential in crop production due to their role in improving crop productivity and food security. Before being granted approval for use, pesticides are subject to regulatory evaluation using a framework designed by the Organisation for Economic Co-operation and Development (OECD). These tests provide evidence of the extent a pesticide persists in the environment and the risks they pose. Although valuable, the tests are conducted under laboratory conditions, which often lack environmental realism and therefore may not accurately reflect pesticide fate and transformation in the real world.

Previous research has shown that when environmental inoculum is taken at different times of year but incubated under the same conditions in the laboratory, pesticide degradation is slower when temperatures were colder in the real environment. Microbial degradation is one of the most important processes in determining pesticide fate and it is unclear if these differences in degradation are due to specific microbial communities not being present at colder times of year, or whether microbial consortia are acclimatized to colder temperatures and therefore are not as active at the higher laboratory temperatures.

Understanding the complexities and interactions of temperature effects on pesticide fate and transformation would provide information to guide regulatory approval of new chemicals and could aid the design of tests used to investigate the environmental fate of pesticides. It would also provide insight into how the microbial communities responsible for pesticide fate and transformation will be affected by a changing climate.

Methodology: *Maximum 150 words*

You will compare pesticide degradation under incubation temperatures of traditional OECD test designs with temperatures more closely aligned to those at the time of environmental inoculum collection from rivers. To determine pesticide degradation, you will use a range of analyses, including liquid chromatography-mass spectrometry. This will be complemented with molecular profiling of microbial communities, including metagenomic analysis, to provide an understanding of how pesticide degradation is linked to the microbial communities present, e.g. are there certain communities which are present or more active and which accelerate pesticide degradation when it is warmer in the real environment. Further work will investigate testing the effect of temperature acclimatization periods on the environmental inoculum prior to testing pesticide degradation.

Training and skills: *Maximum 100 words – excluding CENTA training information*

Students will be awarded CENTA2 Training Credits (CTCs) for participation in CENTA2-provided and 'free choice' external training. One CTC equates to 1⁄2 day session and students must accrue 100 CTCs across the three years of their PhD.

Training will be provided in a range of chemical analyses as appropriate (e.g. HPLC, TLC, LC-MS), molecular techniques (DNA extraction, PCR, sequencing), metagenome sequencing, and bioinformatics.

Partners and collaboration (including CASE):

Name of L1/L2 Partner (where applicable)	
Name of CASE partner (where applicable – project proposal **must** be accompanied by a letter of support from the CASE partner)	Syngenta Unable to provide letter of support at this time.

Further information on partners and collaboration (including CASE): *Maximum 100 words*

It is hoped that Syngenta will be a CASE partner in this project. An internal research proposal at Syngenta has been submitted and a decision on the proposal is expected by January 2023, therefore a letter of a support is not possible at this time. If successful, the student will be required to partake in a minimum 3-month placement with Syngenta at their Jealott's Hill International Research Centre and this will provide valuable industry experience for the student.

Respiratory and Contact Infection Resilience of the Project: *Maximum 100 words:*

The project will comprise a mix of field work, laboratory work and desk based bioinformatic analysis. During any lockdown periods, bioinformatic components of the project will become the focus of the programme.

Possible timeline:

Year 1: Multiple experiments at different times of year assessing pesticide degradation under standard regulatory test regimes and more environmentally relevant temperatures.

Year 2: Determine the impact of laboratory equilibration times on pesticide degradation.

Year 3: Determine microbial taxonomic and functional characteristics which control temperature induced differences in pesticide fate and transformation.

Further reading:

Southwell, R. V., Hilton, S. L., Pearson, J. M., Hand, L. H. and Bending, G. D. (2020) 'Inclusion of seasonal variation in reiver system microbial communities and phototroph activity increases environmental relevance of laboratory chemical persistence tests', *Science of the Total Environment*, 733 (139070).

Further details:

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Information and links at the following webpage:

https://warwick.ac.uk/fac/sci/lifesci/study/pgr/apply