The Lancaster
Environment Centre

LANCASTER UNIVERSITY

The influence of the circadian clock on plant-herbivore interactions.

Why we want to do this science

Circadian rhythms are the endogenous oscillations, occurring with a periodicity of approximately twenty four hours, in the biochemical, physiological and behavioural functions of organisms. Circadian rhythms are controlled by internal molecular clocks, and act to synchronise biological processes with the external environment, thereby optimising fitness. In plants, some stress responses are 'gated' by the circadian clock – in other words, the response to stress is different depending on the time of day. We have recently published data illustrating various effects of light/darkness on the plant response to wounding, and have preliminary evidence linking the circadian clock with changes in gene expression induced by mechanical damage to the leaves of Arabidopsis plants. This in turn suggests that the clock may also modulate defence against insect herbivores.

The aim of this project will be to investigate in detail the interactions between the circadian clock and plant resistance to herbivory. Experiments will be designed to address the following key questions:

- Are Arabidopsis mutants that are either arrhythmic or have altered periodicity affected in their defence against herbivory?
- Can such changes in defence be attributed to gating by the circadian clock of molecular, biochemical and /or physiological responses?
- Are plant-insect interactions affected by asynchrony between the circadian rhythms to which each has been entrained?
- Does photoperiod (daylength) affect plant-herbivore interactions?

We will adopt an interdisciplinary approach, working from the molecular to the ecological scale to unravel both the outcomes of interactions between defence and the clock and the mechanisms underlying these outcomes. The project will provide important new fundamental understanding of both plant herbivore interactions and the functions of circadian clocks, and may have implications for approaches to pest control in crops.

What's in it for you

The project will be part of a wider interest in LEC in the molecular biology, physiology and ecology of pant-insect interactions. The science proposed in the project addresses some fundamental issues in plant biology which are currently the focus of international interest, and if successful, should lead to high impact publications. The studentship will provide training in molecular techniques for measuring gene expression, plant physiology and insect biology.

Who should apply

Applicants should have a background in plant biology or ecology and be interested in taking a multidisciplinary approach to plant science.

The small print

Studentship funding: This project is offered on a self-funding basis, although we are actively seeking funds to support it from a variety of sources. It is open to applications from students with funding or applying to funding sources.

Academic Requirements: First-class or 2.1 (Hons) degree, or Masters degree (or equivalent) in an appropriate subject.

Deadline for applications: Ongoing

For further information, or informal discussion about the position, please contact Dr Michael Roberts (m.r.roberts@lancaster.ac.uk).

Application process: For information on applying please email Andy Harrod (lec.pg@lancaster.ac.uk) and see: http://www.lec.lancs.ac.uk/postgraduate/applications/.

You should address your background and suitability for this project in your personal statement.

Further Reading

Morker K.H., Roberts M.R. (2011) Light exerts multiple levels of influence on the Arabidopsis wound response. *Plant Cell & Environment* 34, 717–728.

Roden L.C. & Ingle R.A. (2009) Lights, rhythms, infection: The role of light and the circadian clock in determining the outcome of plant-pathogen interactions. *The Plant Cell* 21, 2546-2552.

Wang W., Barnaby J.Y., Tada Y., Li H., Tör M., Caldelari D., Lee D.U., Fu X.D., Dong X. (2011) Timing of plant immune responses by a central circadian regulator. *Nature*. 470, 110-114.

Hotta C.T., Gardner M.J., Hubbard K.E., Baek S.J., Dalchau N., Suhita D., Dodd A.N. & Webb A.A.R. (2007) Modulation of environmental responses of plants by circadian clocks. *Plant, Cell & Environment* 30, 333-349.

Covington M.F., Maloof J.N., Straume M., Kay S.A. & Harmer S.L. (2008) Global transcriptome analysis reveals circadian regulation of key pathways in plant growth and development. *Genome Biology* 9, R130.