Institute for Agri-Food Research and Innovation

Title of Studentship (please keep as concise as possible)	Modulating plant immunity using cryptic viruses	
Value of Studentship (tick those that apply)	• Stipend at UKRC rate	☒
	• Full Payment of fees at Home/EU rate Band 1 or 2	☒
	• Annual Direct Costs for project Estimated £6,000pa	
Desired Start Date (if significantly different from call)		
Project Summary (max 50 words) (this will be for advertising via postgradstudentship.co.uk, Jobs.ac.uk and others)	This studentship will explore the role of cryptic viral infections in altering crop stress tolerance towards multiple biotic and abiotic stresses	
Full Project Description (min 1 side A4) (please give a more detailed overview of project and provide details of candidate involvement to include: • Hypotheses they will be investigating • Theoretical underpinnings • Methodology • Training provided • location of training and research)	Plants are natural hosts to a range of symbiotic and pathogenic microbes that can play an important role in altering host tolerance to pests (insects, pathogens) and abiotic stresses (drought, flood,). Rhizobacteria and endophytic microbes are well known to induce tolerance by several mechanisms, including priming existing plant defence responses, termed Induced Systemic Resistance (ISR). Studies on ISR have centered on the ability of a single microbial strain to enhance tolerance towards a single type of stress. However, it is possible that broad range stress tolerance may be achieved, either via inoculation with multiple compatible endophytes, or characterization of an endophyte that primes a central regulatory pathway of stress responses. Mechanisms for single stress priming have in some cases been described, for example endophytes	

	producing an ethylene precursor (1-aminocyclopropane-1-carboxylate (ACC) deaminase) stimulate priming of plant water stress (drought and flood) tolerance (Glick, 2014). However, the regulatory events of potential multiple stress priming are likely to be more complex and remain unclear. Indications have recently arisen through the identification of stress induced small RNA (microRNA, miRNA) in both plant and mammalian systems. miRNAs can be induced by plant microbial infection and can regulate the expression of defense genes such as Glutathione S-transferases (GSTs)) and transporters known to be involved in tolerance against multiple biotic and abiotic stresses (Padmanabhan et al., 2009; Xu., 2013). Intriguingly, endophytic viruses are known to be mediated by GSTs, and plant infection can lead to enhanced tolerance to abiotic stress such as drought and heat (Xu et al., 2008). These studies have centred on known pathogenic viruses, however, the lesser understood asymptomatic viruses may be a potentially novel source of non-selective stress tolerance primers. In a recently completed study, the Edwards group working with scientists at Fera , have identified a range of cryptic viruses in wild grass populations linked to broad-ranging herbicide resistance (Sabbadin et al., paper in submission). The aims of this studentship will be to identify a range of cryptic viruses in crops and weeds and identify the types of stress priming (broad or selective) induced by these infections, identifying the molecular mechanisms underpinning the priming of selective and broad stress tolerance. Hypotheses to be tested during the studentship: • Viral endophytes can selectively or broadly enhance plant tolerance towards different types of environmental stresses, i.e. water stress, pests, chemical (herbicide) stress • Enhanced tolerance is achieved via endophyte induced priming of endogenous stress signalling pathways

	• Primed tolerance towards multiple stresses can be achieved either via inoculation with a combination of compatible (non-competitive) endophytes, or an endophyte that induces a generic stress tolerance mechanism • Priming of stress tolerance genes is influenced by regulatory genes, by miRNAs Methodology • Screen sequence databases library for cryptic viruses in crops, using next generation sequencing to identify new classes of cryptic viruses in both crops and wild plants that may be causally linked to stress tolerance to biotic and abiotic stresses (flooding, drought, insect, herbicide). • Characterise regulatory molecular mechanisms of induced tolerance via a combination of next generation sequencing and proteomics • Using viral infection, or transformation of crops with related RNA synthetic constructs examine the effects of engineered cryptic viral primed resistance on plant signalling pathways and stress tolerance responses. Training *The student will be provided with a powerful suite of research training in applied plant virology (Fera), abiotic stress physiology including herbicide tolerance (NU), next generation sequencing and bioinformatics (Fera) and proteomics and plant biochemistry (NU).* *Additional PhD training in generic skills at Newcastle will be delivered via the graduate school and Schools od Biology and AFRD in line with the University's DTA programme. The student will join the IAFRI doctoral training centre supported by the combined research and training infrastructure at Fera and the SAgE faculty.* References

	Glick, 2014. Microbiological Research, 169:30-39 Padmanabhan et al., 2009, Current Opinion in Plant Biology, 12:465-472 Sasidharan et al., 2015, Plant Physiology, 169:3-12 Xu et al., 2013, Journal Experimental Botany, 64:4271-4287. Xu et al., 2008. New Phytologist, 180:911-921
Name of Supervisors and Institution (min. 2 - supervision must be joint between Newcastle and Fera, Jointly Appointed academics will be classed as Fera)	Neil Boonham (IAFRI/FERA), 50% Catherine Tetard-Jones (Newcastle (Biology)), 50%
To be Completed if Primary location of Student is at Fera Science Ltd: Please give details of facilities, resources and processes that are in place so that support is available to the student whilst located at Fera. These include: i. 10 meeting per year with academic supervisor ii. 3 meeting per year with full supervisor team iii. Systems in place for student to access NCL facilities E.G. Library iv. Plans for continued supervision if one or more current supervisors leaves their employment v. Plans for the student to engage in Newcastle activities that facilitate progression E.G. Postgraduate Conference **If possible provide a draft plan when these activities would take place.** Also include details of any risk assessment that have/will take place at Fera covering the PhD.	Primary location is at Fera under the supervision of Prof Boonham The Edwards's group and Fera have 4 years of prior successful experience of delivering a full HEI and RCUK compliant training to joint students. The full supervisory team will meet every 6 weeks either by skype or face to face meetings at Fera/Newcastle to discuss progress and project planning. During time at Newcastle, the academic supervisor will meet with the student on a weekly basis. The student will have full access to Newcastle University facilities. The student will join an active postgraduate community in the IAFRI doctoral training centre supported by the combined research and training infrastructure at Fera and the Newcastle University SAgE faculty. This will involve PhD training in generic skills at Newcastle, delivered via the graduate school and Schools of Biology and AFRD in line with the University's DTA programme. An essential component of the students' progression will be engagement with the annual postgraduate conference.
Person Specification (please specify qualifications and skills required for this studentship E.g.	Plant pathologists, physiologists and biochemists are particularly encouraged to apply.

• Discipline area • English Language requirements Additional skills)	A good grounding in science communication in English in both writing and presentation skills is required. The student will need to demonstrate self-motivation and an ability to work flexibly between the two institutions