PhD studentship in Plant-microbe Interactions, Agroecology & Sustainable Agriculture
Start date – 1st October 2017
Supervisors: Dr Richard Quilliam (University of Stirling), Prof Adrian Newton & Dr Pete Iannetta (JHI, Dundee)

Developing novel seed treatments for grain legumes: optimising sustainable outcomes in agricultural systems

We are seeking a highly motivated individual to carry out PhD research in the field of agronomy, plant physiology, crop production and plant-microbe interactions. This studentship is jointly funded by the University of Stirling, Legume Technology Ltd., and the Processors and Growers Research Organisation (PGRO), and the James Hutton Institute. The project will provide a platform to build an interdisciplinary research and development career in the field of Sustainable Agriculture & Agroecology.

The funding for this studentship has already been secured and the successful applicant must be able to start in October 2017. The student will be based at the University of Stirling, supervised by Dr Richard Quilliam, but will also be registered at the James Hutton Institute (JHI), Dundee, and benefit from extensive supervision & collaboration with Prof. Adrian Newton & Dr Pete Iannetta.

Background - Increasing food security whilst simultaneously reducing environmental impacts and enhancing resilience to future climate are the key challenges facing agriculture. Agronomic sustainability can be facilitated by incorporating legume crops, such as peas and beans, into crop rotations. Legumes are able to fix atmospheric nitrogen through their symbiotic root-nodule bacteria (e.g. *Rhizobia* spp.), and thus reduce the need for synthetic fertiliser input. Successful root nodulation relies upon agricultural soils having a sufficiently high inoculum potential. However, intensively farmed soils are often lacking in populations of rhizobia due to the rotation of non-leguminous crops and high application rates of synthetic nitrogenous fertilisers. A strategy to combat this is to directly treat the seed with a concentrated inoculum of rhizobia, which ensures suitably high concentrations of root-nodule bacteria in the rhizosphere of the growing root. Because this technology is suitably advanced, there is now the opportunity to enhance and optimise this process by combining seed treatments that are able to simultaneously increase biological nitrogen fixation and induce disease resistance through the addition of plant growth-promoting rhizobacteria (PGPR) and resistance elicitors. The mechanistic and physiological basis of such seed treatments however, needs critical evaluation in a sustainable agricultural context. Therefore, the focus of this studentship will be to develop novel legume-microbe seed treatments as either practical liquid, solid or seed coating formulations, and assess subsequent root nodulation, plant development and disease resistance in peas and faba bean, which are important agronomic legume species in both the UK and in the developing world. In addition to the benefits of legume seed treatments for European

agricultural systems, this project will also explore how this technology can be transferred and adapted to local situations in developing countries for adoption by resource-poor farmers.

Specifically, the objectives of this project are to:

1. Characterise novel rhizobial isolates for improved inoculum longevity and improved N-fixing efficacy

2. Combine rhizobial isolates with other key symbionts such as PGPR and resistance elicitors (e.g. biomass-derived elicitors)

3. Determine the mechanistic and physiological basis of these novel seed treatments on different legume genotypes in terms of subsequent plant fitness, growth & yield

Training
By combining physiological, biochemical & microscopy methods to quantify the benefits of novel seed treatments in terms of crop growth parameters and disease incidence in both pot-grown and field-scale trials, this PhD project will provide important & timely transformative and sustainable agricultural solutions to address the increased demand for agro-ecological strategies to increase crop yields.

This studentship will provide a platform to build an interdisciplinary research career in sustainable agronomy, crop science & plant pathology. Extensive skill development at the field-scale will include comprehensive training in agronomic sampling techniques, while the student will also benefit by developing broad expertise in soil & crop science. The studentship will also broaden the scope of the applicant's skills base by providing specialist training in microbiological techniques. The student will benefit from co-supervision at the James Hutton Institute and use of lab and extensive field trial facilities at the JHI site at Dundee. The student will also benefit from becoming fully integrated into the commercial R&D culture of both industry partners, and the student will spend significant periods of time at both partners in order to develop wider skills in commercial R&D, and to foster crucial research-industry links. Supervision and training will be tailored to the individual needs of the student, who will benefit from internationally-transferrable analytical, field-based and project management skills.

This is a 3 year PhD studentship with a stipend set at the RCUK national rate (forecast to be £14,296 per year), and is only open to UK and EU citizens. The entry qualification is a first class or upper second class honours degree and/or a relevant postgraduate degree, in either agronomy/agriculture or a biological/environmental science.
The deadline for applications is midnight on Thursday 29th June 2017.

Please email a CV and covering letter with the contact details (including email addresses) of two referees to Dr Richard Quilliam (richard.quilliam@stir.ac.uk). Your covering letter should clearly set out your suitability and motivation for this PhD with reference to your past experience and achievements. Informal enquiries should be directed to Dr. Richard Quilliam: http://rsquilliam.wordpress.com/