

Project title and location:

Developing next-generation multiplexed assays for in-field monitoring of crop pests and physiological status. NEWCASTLE BASED

IAFRI background:

The Institute for Agri-Food Research and Innovation (IAFRI) is a joint venture between Newcastle University and Fera Science Ltd and a unique model for how universities can work with private sector research organisations. It operates under a private-public ownership to deliver both public good research and services as well as innovation and wealth creation in strategically important industrial sectors in the UK. Students will have a unique opportunity to benefit from supervision and facilities at both the Newcastle and Sand Hutton campuses to deliver research with real-world impact.

Lead Supervisors (and contact): For more information and details on how to apply please contact Prof. William Willats, William.willats@newcastle.ac.uk, 07976859960

Key research gaps and questions:

Crop production faces significant challenges in relation to sustainability, resilience and profitability. Increased output is required to meet the needs of a growing population but this must be achieved in the face of increasing herbicide and pesticide resistance, a stricter regulatory environment and a diminishing repertoire of agrichemicals, climate change, and increasingly globalised production.

Meeting these challenges requires the development of sophisticated tools enabling farmers to use site-specific management tactics that maximize yield and resources while reducing costs and environmental impacts such as over-fertilization and the broad applications of pesticides.

The goal of this project is to develop a technology platform that will produce a new generation of in-field monitoring devices based on lateral flow assays (LFAs). Innovative aspects of the work include: 1) the use of microarray robots to manufacture LFAs capable of detecting multiple bio-marker targets simultaneously, and 2) the integration of LFAs into wider diagnostic work flows and decision-making tools based on smart-phone technology.

Project Description:

Currently, almost all agri-diagnostic LFAs detect only one target biomarker. The new generation of multiplexed devices we propose will display multiple antibodies capable of detecting several biomarkers simultaneously. We will use state-of-the art microarray robotics to print antibodies as discrete spots onto LFA internal membranes. With multiple industry partners, we will develop bespoke smartphone software that will 1) provide semi-quantitative outputs; 2) lead the user through a work flow that will collect other relevant data from the sampling site (such as geolocation, photographs and observations from the user). This metadata will add value to the value of LFAs and be an important resource underpinning research into the underlying biology of crop health.

The PhD project has three main interdependent components. The first is the development of a generic technology platform, based on microarrays and new software that will support the development of multiplexed agri-diagnostic LFAs. The second stage will focus specifically on the using the new technology to produce multiplexed LFAs for detection of potato viruses. The third stage will focus on LFAs for detection of herbicide resistance in grass weeds.

The project will involve interacting with a variety of academic and industry partners and this will provide exposure to a wide range of biochemical, molecular, agronomic, and computing and data handling techniques. Specifically, training will be provided in: antibody immobilisation and validation; application of antibodies in LFAs; sample preparation from crop materials; microarray robotics for biomolecules;

design and printing of antibody arrays; quantification of biomarker levels in target materials; interpretation of diagnostic outputs feeding into pest management decision making; design of LFA scanning and quantification software; design of smart phone work flow tools.

Desired skills:

The candidate should have a BSc in a biology, biochemistry or related subject and have the personal skills and enthusiasm for working with a multidisciplinary team of industrial and academic partners. Although extensive training and supervision will be provided, the successful candidate will be able to think and operate independently within the project framework and have the vision to identify and act on new opportunities as they arise. The candidate will be well organised and be skilled at presenting data and ideas to project partners.

