New Project Summary Report for CP 099b: Evaluation of UK Industry requirement for on-site diagnostics tests

Project Number	31100992
Title	Evaluate the UK Horticultural Industry requirement for on-site diagnostic tests for crop pathogens and their use within Disease Management Systems.
Short Title	CP 099b
Lead Contractor	University of Worcester
Other Contractors	
Start & End Dates	30 April 2013 - 30 September 2013
Industry Representative	Andy Richardson, Allium and Brassica Centre
Project Budget	£14,830
AHDB Contribution	£14,830

The Problem

Project summary
The ability to diagnose plant pathogen levels early, accurately, rapidly and at a low cost will assist in the prediction of plant diseases ahead of infection. This will enable disease control measures to effectively be put in place and reduce the unnecessary and / or routine fungicide applications. Controlling the disease early is key to reducing subsequent disease epidemics. Biological control agents need to be applied early to improve their efficacy and the development of on-site tests will greatly improve the potential impact of biological control agent through the identification of early asymptomatic disease development.

Background
Economic losses resulting from disease epidemics can be reduced by the accurate detection of crop pathogens. Early diagnosis can provide the grower with useful information on optimal crop rotation patterns, varietal selections, control measures, harvest date and post-harvest handling.
Classical methods for the isolation and identification of crop pathogens are however commonly used only after disease symptoms are observed. Such processes are often time consuming and require considerable expert taxonomic training for accurate identification. These processes frequently delay the application of control measures and often at potentially important periods in crop production.
The ability to identify the disease ahead of symptom appearance is critical if disease epidemics are to be controlled successfully with reduced inputs. Identification of effective biological control agents would also be important.

UK Government and European Union policy legislates the requirement to rationalise crop protection and production inputs. An opportunity exists to develop and deploy rapid, simple and inexpensive on site tests to alert growers to crop pathogen incidence in soils, water and air. This system can be carried out either

prior to crop planting and/ or during the growing period to reduce the risk of economic losses through proper targeting of effective control inputs.
The ability to evaluate and quantify disease potential quickly provides the narrow window available to apply useful biological control agents when necessary. The increasing use of biological control agents in comparison to conventional pesticides are an important EU policy area.

Advances in Immunoassay systems offer the potential to revolutionise diagnostic assay systems in Agriculture and Horticulture. Immunoassays are analytical tests that use antibodies. They offer a biochemical process which can be used to develop rapid diagnostic systems. In diagnosis they are often used to confirm a visual diagnosis or facilitate detection at a sub clinical level. Initially developed for the medical healthcare industry the immunoassay has since been adopted across a wide range of disciplines. In agriculture, assays were first developed for the detection of plant viruses and bacterial plant pathogens. The advent of monoclonal antibody technology has proved instrumental in the development of fungal plant pathogen test applications.

Immunochromatographic tests (ICT's or lateral flow tests or simply strip tests), based on immunoassays with a direct visual reading, have been developed as simple and powerful tools for the preliminary screening of pathogen contaminated samples. Strip tests have gained great popularity, first of all for home pregnancy testing and more recently for point-of-care testing (HIV, Malaria, Hepatitis, Drugs of Abuse) due to their simplicity and speed The ICT's have high sensitivity, a user-friendly format, a long-term stability over a wide range of conditions, the results are obtained in a very short time and, moreover, inexpensive materials and cheap fabrication may be used. Most well-known over-the-counter tests are the pregnancy test, which detects the pregnancy marker hormone in a urine sample. In addition to home diagnostic kits, there are applications of these assays in many diverse areas (veterinary medicine, farming, food quality control, market gardening and environmental monitoring).
While a number of commercial on-site immunoassay formats have been successfully developed for the detection of crop pathogens these are limited to detection of the pathogen in planta and only once symptom development is expressed. Recent HDC funded studies however have demonstrated the potential application of ICTs to monitor diseases of vegetable plant pathogens in air, soil and water, prior to infection. These test systems are either available (ringspot) or with commercialisation phased over the next few years (light leaf spot, dark leaf spot, powdery mildew, white blister and onion downy mildew)

Rapid onsite tests (ICT's) provide the opportunity for growers to monitor disease inoculum of horticultural crop pathogens in a range of cropping environments and throughout the growing season. The ICT system provides the grower with a laboratory at his fingertips but at a fraction of the cost.

Benefits to industry
UK horticultural crop pathogens which pose significant economic risk to the Industry would be reported. The requirement to develop rapid, inexpensive and onsite tests for key pathogens of economic importance would be evaluated. The application of these tests within integrated disease control systems would be assessed.
The ability to diagnose pathogen levels accurately, rapidly and at a low cost will assist in the prediction of plant disease occurrences. This will enable the appropriate disease control measures to be put in place only when required and at the optimal time for active efficiency.
UK Government and European Union policy legislates the requirement to rationalise crop protection and production inputs. An opportunity exists to develop and deploy rapid, simple and inexpensive on site tests to alert growers to crop pathogen incidence in soils, water, air and infected plant tissue.
The report will inform HDC thinking on the development of the next generation of antibodies for development into 'onsite' diagnostic devices and will be discussed at the HDC Panels. Findings will be presented within HDC News output.

Aims and Objectives

Project aim

Evaluate the UK Horticultural Industry requirement for on-site diagnostic tests to monitor crop pathogens and their use within Disease Management Systems.

Identify cross-sectoral pathogens which have significant economic impact on UK horticultural cropping systems. When identified then this information will inform the next stage of new disease /antibody targets in the HDC diagnostics portfolio for development into 'in field lateral flow device' tools.

Project Objectives

• Identify plant diseases / pathogens which have a significant economic impact on the UK horticultural industry.
• Provide a Gap Analysis on where it would be economic to develop and use 'on-site' tests to improve the cultivation process and identify disease risk.

• Of those identified pathogens indicate those which could feasibly be developed into an onsite diagnostic.

Approach

Within the UK Horticulture Industry, economically important plant pathogens will be identified and their significance reported. A literature review will identify current methods of disease assessment and strategies used for controlling disease outbreaks. Key diseases where ICTs (rapid, on site, disposable tests) could be developed to identify disease epidemics ahead of infection and for routine monitoring of disease throughout the growing season would be identified and their potential use within integrated disease management systems evaluated.

This information will then be used to select the next range of diseases /antibody targets for development into lateral flow devices (LFD) for use 'on-site' in crops for early detection and forecasting of disease occurrence.

The final selection of target diseases highlighted by this study will be made following industry consultation at Panel and Board level.