Work Package 1.5: Potato Pathology

- **Required Output 1: Epidemiology to explain disease incidence for better management of PCN, late blight, Erwinia, powdery scab and viruses.**

Summary

Observing the structure of pest and pathogen populations and how these populations change, provides information on factors such as pathogen spread, the introduction or selection of new pathogens, and the durability of cultivar resistance to these pathogens. Population studies on the disease causing organisms potato cyst nematode (PCN), viruses PMTV, PVY, PVA and PLRV, the late blight pathogen *Phytophthora infestans*, the bacterial soft rot pathogen *Pectobacterium* (formerly *Erwinia*), and the powdery scab pathogen *Spongospora subterranea*, are leading to new information on changing pathogen populations, the role of pathogen proteins in disease resistance, new ways to control crop contamination and the potential impact of climate change. For example, population studies on *P. infestans* have identified the increase of a dominant genotype (13_A2) in GB, which is more aggressive than other isolates. Its epidemiology and ability to overcome various sources of host resistance in Scotland is being investigated. Genomics techniques have identified genes within the bacterial pathogen *Pectobacterium* that suggest it may live naturally on wild plant species (a potential source of seed tuber contamination). Recent evidence suggests that this is indeed the case, and the extent of this contamination is now being examined. Two types of *Spongospora* sporeballs have been identified in Scotland. The interaction of these types with virus PMTV (which uses *Spongospora* as a vector), and plant roots is being examined.

- **Required Output 2: Development of crop protection strategies for key pests and diseases leading to reduction in pesticide usage.**

Summary

Crops can be protected from disease in a number of ways, including the development of resistant cultivars and knowledge based on pathogen movement and changes in pathogen populations. To this end, field and laboratory studies have demonstrated that the behaviour of the peach-potato aphid (*Myzus persicae*) can be altered by the crops it encounters, making it possible to design crop protection systems to reduce vector aphid movement within crops, and hence limit the spread of virus-induced diseases. PCN decline rates in field soils have been investigated under different cultivar susceptibilities to aid development of a decision support package.

- **Required Output 3: Information on the nature of host resistance and susceptibility to the key diseases that will lead to durable field resistance.**

Summary

The development of resistant potato cultivars is key to sustainable crop production. Such an approach will help to: (i) reduce the need for chemical inputs (especially important as many nations, including those within Europe, aim to decrease inputs), thus improving the environmental safety of potato production; (ii) protect against pathogens for which there are no chemical controls (e.g. viruses and bacteria); and (iii) protect against non-indigenous pathogens that may arrive and establish in Scotland due to globalisation and climate change. Our aims are to understand more about different aspects of potato defence against disease causing organisms and to use this information to develop durable, broad-spectrum resistance to a number of pathogens. Significant progress has been made towards understanding some elements of plant resistance, with new sources being identified. We have developed and/or tested systems that allow us to functionally characterise and test genes involved in pathogen attack and plant defence. These systems have been used to improve our knowledge of genes involved in pathogenesis by viruses, nematodes, bacteria and oomycetes (*P. infestans*) and those involved in potato resistance to these pests and pathogens Novel sources of natural resistance to PVY and *Pectobacterium* in *S. phureja* have been identified while "novel markers for breeding" are in development in collaboration with WP 1.2.

- **Required Output 4: Development of appropriate sampling strategies, diagnostics and interpretation for use to support industry or government.**

Summary

In order to track pathogens it is important to have accurate and reproducible methods for their sampling, detection and differentiation (fingerprinting). This has important implications for epidemiological investigations and for the development of crop protection strategies. DNA fingerprinting (marker) methods are being developed to study: (i) *P. infestans* populations for outbreak monitoring and (ii) insecticide resistant aphid populations (to assist in SASA's decision support systems). A novel diagnostic has been developed for the skinspot pathogen *Polyscytalum pustulans,* and testing of PCN diagnostics has been performed in association with SASA, for closer monitoring of these pathogens in line with legislation to withdraw control chemicals. The interpretation of diagnostics for two aphid transmitted viruses (PVA and PVY) has improved through industrial collaboration. The short term aim of this required output "Diagnostics/sampling:

interpretation of field based diagnostics for industry use" has been achieved for some pathogens and is progressing well for others.

- **Required Output 5: Consider the impact of climate change on crop health and identify future plant health risks.**

Summary

A report entitled 'Impact of Climate Change on Pests and Diseases of Potatoes in Scotland: Risks and Recommendations' is now complete and has been passed to the PC Ltd and SASA for comment. This report has flagged up a number of potential threats to Scottish potato production systems. Examples include new threats such as *Dickeya* and root knot nematode, and an increased threat from indigenous pathogens such as insecticide resistant aphids and their viruses, and *P. infestans*. This work was recently presented at the Crop Protection in Northern Britain conference in February 2008, and included data from predictions using the climate change modeling software "CLIMEX" in association with SAC.

- **Required Output 6: Knowledge transfer on best practice for crop health.**

Summary

Knowledge transfer from WP 1.5 has engaged all five target groups, including policy, stakeholders, public, commercial and scientific. Over the first two years of the WP we have delivered over 350 KT events, of which almost half have been to a non-scientific audience. Scientifically, we have published 46 papers (including papers in high impact journals such as *Nature*), and presented our work at more than 100 meetings/conferences.

We continue to effectively communicate the main messages to a range of end users using a range of media. This is achieved through close contact between SCRI, SAC, SASA, links to the agrochemical industry, growers, agronomists (Scottish Agronomy have incorporated much of the work in WP 1.5 into their grower materials) and stakeholders (e.g. PC Ltd, Scottish Society for Crop Research, Insecticide Resistance Action Group and Pesticide Safety Directorate). We have engaged with journalists, the popular press and presented findings at demonstration farms and events such as British Potato 2007, Potatoes in Practice, the Blight Forum and Crop Protection in Northern Britain. Links to the EU and beyond, ensure that we continue to effectively communicate the main messages of our work to wide audiences of government, stakeholders and industry. Our main link to policy is through SASA, where we interact on areas such as PCN and aphid monitoring, and the threat of new pathogens, (e.g. *Dickeya*). In addition to the above, scientific publications, and presentations at national and international conferences ensure that relevant data is

communicated to the science community. The short term aim of this required output “Improved management model for PCN; Advice and guidelines for disease and pest management derived from farm trials” has been achieved.