

3rd International *Spongospora* Workshop

Satellite meeting of the 22nd Triennial Conference of the European Association for Potato Research, Scandic Hotel, Oslo, Norway. 6 July 2004

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INTRODUCTION

This report outlines Prof Richard Falloon's involvement with organisation of, and participation in, the 3rd International *Spongospora* Workshop (3RD ISW), held in Oslo, Norway, on July 6, 2014. The Workshop was convened in conjunction with the 22nd Triennial Conference of the European Association for Potato Research. Information presented at the Workshop is also briefly summarised in this report.

ORGANISATION OF THE 3RD INTERNATIONAL SPONGOSPORA WORKSHOP

The Organising Committee of the 3rd ISW included Dr Ueli Merz (co-ordinator, Switzerland), Dr Iain Kirkwood (Potatoes NZ, New Zealand), Prof Richard Falloon (New Zealand), Dr Alison Lees (James Hutton Institute, Scotland), and Prof Calum Wilson (University of Tasmania, Australia). The Committee met regularly, by web-based links, during the 8 months prior to the Workshop. Dr Merz also maintained regular consultation with Dr Arne Hermansen, Chairperson of the 22nd Triennial Conference of the European Association for Potato Research.

The 3rd ISW included 38 participants from 14 countries. This was the largest of the three international workshops that have focused on *Spongospora subterranea*, the potato diseases caused by this pathogen, and *Pomovirus solani* (potato mop-top virus) which is transmitted by *S. subterranea*.

Sixteen papers (13 oral papers and three posters) were presented at the Workshop. The papers were co-authored by a total of 69 researchers. The presentations included: an introductory review on current knowledge on *Spongospora* and disease management, followed by three papers on *Spongospora* biology and detection, four on host resistance to the pathogen, seven on control of *Spongospora* diseases, and one paper describing the initiative to establish a framework for international research collaboration.

SUMMARY OF PAPERS PRESENTED AT THE 3RD INTERNATIONAL *SPONGOSPORA* WORKSHOP

The presentation at the 3rd ISW outlined previous and current research being carried out in 14 countries, in North and South America, Australasia, Europe and Asia. The Workshop Organising Committee will submit a full report on the 3rd ISW for publication in *Potato Research*, the journal of the European Association for Potato Research.

Papers presented at the 3rd ISW are summarised below, grouped in the five topic areas addressed at the Workshop. The paper presenters are shown in bold font.

1. Workshop introductory paper

Richard Falloon (New Zealand) and **Ueli Merz** (Switzerland) summarised previous knowledge on *Spongospora* diseases of potato, and presented prospects for effective management these diseases in potato production. Origins and historical international dissemination of *S. subterranea* were reviewed, and potato crop management practices for *Spongospora* disease control were outlined for crop stages of pre-planting, planting, or during crop growth. Suggested future research and technology transfer requirements were: implementation of practical disease management by potato producers; increased knowledge of *Spongospora* genetics and host/pathogen interactions; identification of markers to assist potato breeding for resistance to the pathogen; optimisation of mass screening to identify useful resistance; and development of potato cultivars with resistance to both *Spongospora* root gall and tuber powdery scab.

2. *Spongospora* biology and detection

Kiwamu Tanaka and co-authors (Washington State University) presented results from light and electron microscopy that showed how starch levels reduce in potato roots as *Spongospora* sporangia develop, indicating how the pathogen manipulates host plants for inoculum development.

Julie Pasche and associates (North Dakota State University) outlined research that has determined the complete genome of *Spongospora subterranea*, from root galls from a single potato plant infected by the pathogen, and from powdery scab on tubers from a commercial potato field. This genome resource has provided increased understanding of populations of the pathogen, and gives background for potential development of strategies for management of powdery scab and potato mop-top virus.

Karima Bouchek-Mechiche and Marie Hervet (INRAE-IGEPP, Le Rheu, France) outlined development of *Spongospora* detection and quantification tools for routine monitoring in epidemiology studies, including detection of the pathogen in different field soils, greenhouses, and potato storage facilities. Detection sensitivity protocols were compared, using real-time PCR. DNA extraction from soil has been automated, using a platform that allows extractions from up to 380 different samples, and this system will be assessed for pathogen detection in potato multiplication substrates other than soil.

3. Potato resistance to *Spongospora*

Samodya Jayasinghe and co-authors (Washington State University) outlined research showing how salicylic acid plays a pivotal role in resistance to *Spongospora* infection. Their study used transgenic hairy root lines of potato to examine their reactions to the pathogen, and demonstrated that salicylic acid mediates defence against *Spongospora*. This knowledge could be utilised for developing strategies for management of *Spongospora* diseases through host plant resistance.

Maria de la O Leyva-Pérez and international collaborators (from Australia, Chile, Ireland, Israel, the Netherlands, South Africa, Switzerland, and the United States of America (USA)), presented results from comparative genomics of *S. subterranea*. These demonstrated potential to develop pangenome knowledge as a resource for potato pathology and breeding.

Cindy Kristelijn and co-authors from HZPC Research B.V., the Netherlands, outlined development of a practical phytotron-based system for identifying *Spongospora* resistance (to root galling and tuber powdery scab) in potato germplasm lines. Effects on disease expression of temperature, humidity, light spectra, growth substrates, time of inoculation, and inoculum origin and concentration, have been assessed. Practical methods have also been developed to demonstrate host variety differences to *Spongospora* infections. These methods are being used by HZPC's commercial potato breeding activities.

Ibrahim Kutay Ozturk and collaborators in the USA (at the Universities of Madison Wisconsin, Maine, and Hawai'i Mānoa, and in the USDA-ARS), presented results showing that *Spongospora*-infected 'Silverton' potato plants had increased susceptibility to late blight and decreased infections of white mould, but 'Goldrush' and 'Atlantic' plants had increased susceptibility to white mould. This emphasises the complexities of interactions between potato, *Spongospora* and other potato pathogens, as new knowledge to support potato breeding for disease resistance.

4. Control of powdery scab and *Spongospora* root infection

Ingrid Martinez and associates (Instituto de Investigaciones Agropecuarias, Los Lagos and La Serena, Chile) described how soil potassium and magnesium ratios influence *Spongospora* root infections in potato plants. K:Mg ratio of 0.3 gave least *Spongospora* infection, while infections were greater at K:Mg of 0.4 (54% more root galls), and 0.6 (51% more galls). At K:Mg of 0.6, and after applications of the pesticide Shirlan® 500 SC, root galling was 40% greater than at K:Mg of 0.3.

Lea Hiltunen and co-authors (Natural Resources Institute Finland, University of Helsinki, and the Potato Research Institute Finland) assessed weeds and potential rotational crops as alternative hosts of *S. subterranea*, in two growing seasons and 20 potato fields with histories of powdery scab. No root galls were observed on any of the sampled plants. However, *Spongospora* DNA was detected in plants of 19 weed species (from 11 families), and in all of the rotation crop plants assessed. This research emphasises the importance of alternative hosts of *Spongospora*, and that weed control and rotation crop selection are important for effective powdery scab management.

Ivette Acuña and collaborators (Instituto de Investigaciones Agropecuarias, Servicio Agrícola y Ganadero, and Pontificia Universidad Católica de Chile, Chile) described research that has assessed: effects of *Spongospora* diseases on seed tuber quality; potato cultivar susceptibility; chemical and biological controls of *Spongospora* diseases; irrigation for reduced disease; and pathogen detection and quantification in soils. These studies have identified appropriate tools for integrated management of *Spongospora* diseases.

Amy Charkowski and associates in the USA (Colorado State University, Virginia Tech, North Dakota State University, Oregon State University) noted that potato mop-top virus was first only detected in Maine in 2002, but that the virus has subsequently spread to most USA potato-producing regions. After occurrence of powdery scab in a potato minituber production facility, *S. subterranea* was also detected in commercial potting mixes, which has changed minituber production methods to hydroponics systems, and to use of routine testing for the pathogen in peat-based potting mixes. The roles of soil type, moisture, temperature, potato variety, and soil microbiomes, for *Spongospora* inoculum increase, PMTV incidence, and powdery scab and spraing development, are being assessed in field trials in four regions of the USA.

Stuart Wale (Aberdeenshire, United Kingdom) outlined experience with soil testing for *Spongospora* detection in Scotland. Powdery scab has declined as a problem in Scottish potato production, but soil testing is used by many potato producers, continuing to provide confidence to grow *Spongospora* susceptible potato cultivars in low risk soils. The test also provides decision support for use of fluazinam in high powdery scab risk situations, which has been important for the reduction of *Spongospora* diseases during the last 15 years.

Calum Wilson and co-workers at the University of Tasmania (UTas), Australia, outlined a recent study to assess a bacterium selected from potato plant rhizospheres for effects on

Spongospora diseases. The bacterium interfered with natural chemical signalling processes in soil, reduced capacity of *S. subterranea* to detect potato hosts, prevented resting spore germination, and reduced zoospore chemotactic location of host roots. These processes reduced expression of Spongospora root and tuber diseases, and also increased potato root mass and tuber yields.

Calum Wilson presented a second paper (in association with different UTas researchers) on novel methods for management of powdery scab. This paper described ongoing studies of new approaches that target soilborne *Spongospora* inoculum, and potato infection and disease development. These potential control methods are being assessed as improvements for Spongospora disease management.

5. International Potato Research Partnership

Iain Kirkwood (Potatoes New Zealand Inc.) outlined the initiative to create an International Potato Research Partnership, which has been promulgated in recognition of, and response to, short and long term international changes in potato industries. The initiative is related to achieving United Nations (UN) sustainability goals, within the Paris Agreement to the 2015 UN Framework Convention on Climate Change. The initiative aims to provide an integrated approach to utilizing research funding on an international level, and improve research progress through scientific exchange and collaboration. The Partnership will initially involve research collaboration between Australia, New Zealand, the United Kingdom, South Africa, Germany, the Netherlands, and the African Potato Coalition, and several other countries and organisations have expressed interest in joining the association. *Spongospora* diseases are likely to be among initial foci of the Partnership.

PUBLICATION OF THE PROCEEDING OF THE 3RD INTERNATIONAL SPONGOSPORA WORKSHOP

The 3rd ISW Organising Committee plans to publish abstracts of the 16 papers presented at the Workshop. This will likely be in *Potato Research*, the journal published by the European Association for Potato Research. Publication of the Workshop “Proceedings” will depend on acceptance of a manuscript containing information about the Workshop, and abstracts of the papers presented. Author approvals have already been obtained for submission of this manuscript to *Potato Research*.

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