

APPS 2009

Plant Health Management: An Integrated Approach

29 September – 1 October 2009
Newcastle City Hall

ISBN 978-0-646-52919-6



Contents

Welcome.....	2
Conference Organising Committee.....	2
Sponsors	3
Exhibitors	4
Conference information	5
General information	5
Social program	6
The McAlpine lecture.....	8
Keynote biographies	9
Venue map.....	10
Program	12
Oral abstracts.....	19
Poster abstracts	123
List of posters	124

Welcome

On behalf of the Local Organising Committee welcome to Newcastle and the 17th Australasian Plant Pathology Society Conference, an event that marks the 40th (or Ruby) anniversary of the Australasian Plant Pathology Society. It provides us with a good opportunity to reflect on the achievements of our profession over four decades of unprecedented discovery about the nature and management of plant disease. It is also a time to ponder the directions of our profession amidst the challenges posed by emerging and persistent plant diseases, food security, climate change, water shortages, rising atmospheric carbon dioxide levels, bioterrorism, consumer safety and preferences, and the opportunities presented to agriculture and horticulture by biofuels, phytomedicines and leisure activities.

The conference theme 'Plant Health Management: an integrated approach' addresses these challenges from three angles—fundamental discovery, the application of these discoveries to practical problems and the adoption of research. Local and international keynote speakers have been invited to challenge you with their perspectives on the big questions in plant pathology. Many of you will have already been challenged by, and enjoyed, the supporting program of workshops and field trips.

Newcastle is a bustling, historic, post-industrial seaside city boasting exciting cultural activities, superb beaches, and other nearby attractions including the Hunter Valley, Barrington Tops National Park and more superb coastal scenery. Please take time to enjoy the location, catch up with friends and colleagues, meet new ones, and return home invigorated, wiser and happy.

David Guest

Conference Convenor, APPS 2009

Conference Organising Committee

- David Guest, Convenor
- Rosalie Daniel
- Robert Park
- Peter Magee
- Nerida Donovan
- Len Tesoriero
- Angus Carnegie
- Chris Steel
- Gavin Ash

Workshop Convenors

Microbial ecology—concepts and techniques for disease control
—Kerry Everett

Tree Pathology Workshop
—André Drenth and Angus Carnegie

Magical Mystery Vegetable Tour
—Len Tesoriero and Nerida Donovan

Biology and management of organisms associated with bunch rot diseases of grapes—Chris Steel

Conference Secretariat

Conference Logistics*
PO Box 6150
Kingston ACT 2604
















02 6281 6624 [ph]
02 6285 1336 [fx]
0448 576 105 [mobile]
conference@conlog.com.au
www.apps2009.org.au

*acting as agent for APPS



Sponsors

The Local Organising Committee gratefully acknowledges the support of our sponsors:

Conference sponsors	Grains Research and Development Corporation	 Grains Research & Development Corporation	
	HAL	 <i>Know-how for Horticulture™</i>	
Gold sponsor	APPS		
Silver sponsor	Nufarm Australia and BASF		 The Chemical Company
Welcome Reception	Cooperative Research Centre for National Plant Biosecurity		
International speaker and post-conference tour sponsor	Grape and Wine Research and Development Corporation		
Keynote speaker	Forest and Wood Products Australia Limited		
Lunch, Day 2	Agrichem		
Supporters	Plant Health Australia		Lomb Scientific
			
	AusVeg		The Crawford Fund
			
	Mars		The University of Sydney
			

Exhibitors

APPS



The Australasian Plant Pathology Society is dedicated to the advancement and dissemination of knowledge of plant pathology and its practice in Australasia. Australasia is interpreted in the broadest sense to include not only Australia, New Zealand and Papua New Guinea, but also the Indian, Pacific and Asian regions. Although the Society's activities are mainly focused on the Australasian region, many of the activities of our members are of international importance and significance.

The Society was founded in 1969. Our members represent a broad range of scientific interests, including research scientists, teachers, students, extension professionals, administrators, industry and pest management personnel.

FOR MORE INFORMATION:

Dr Peter Williamson
Business Manager
APPS Inc

Telephone (07) 4632 0467
Facsimile (07) 46378326
www.appsnet.org

Leica Microsystems



Leica Microsystems is a leading global designer and producer of innovative high-tech precision optics systems for the analysis of microstructures.

It comprises 11 manufacturing facilities in eight countries, sales and service companies in 20 countries and an international network of dealers; the company is also represented in over 100 countries and the international headquarters are based in Wetzlar, Germany.

Leica Microsystems is one of the market leaders in each of the fields of microscopy, confocal laser scanning microscopy, microscope software, specimen preparation and medical equipment. The company manufactures a broad range of products for numerous applications requiring microscopic imaging, measurement and analysis. It also offers system solutions in the areas of life science, including biotechnology and medicine, as well as the science of raw materials and industrial quality assurance.

Specific to this conference, we will be displaying automated compound and stereoscopic microscopes highlighting our imaging systems using Montage, multifocus 3D imaging and Web Module allowing viewing and analysis of images from a remote station via internet.

FOR MORE INFORMATION:

1800 625 286 [ph]
www.leica-microsystems.com

Leica Microsystems Pty Ltd
Unit 3, 112-118 Talavera Road
NORTH RYDE NSW 2113

Nufarm



Nufarm Australia Limited and the link with BASF Australia Limited.

Nufarm has become a successful crop protection company based in Australia but now with global activities that place it at number eight in the global ranking of agrochemical companies. The Nufarm head office is based at Laverton North in Victoria.

In 2004 Nufarm entered into an agreement with BASF Australia Limited for Nufarm to market and develop BASF products within Australia. BASF has an excellent record for developing new horticultural products, especially the discovery of new fungicides.

For further information on the Nufarm/BASF range of products contact:
doug.wilson@au.nufarm.com

FOR MORE INFORMATION:

Doug Wilson
R&D Projects Co-ordinator
Nufarm Australia Limited

Telephone (03) 9282 1427
Facsimile (03) 9282 1022
Mobile 0427 806 386
e-mail: doug.wilson@au.nufarm.com

Conference information

Registration desk

The registration desk is located in the Concert Hall Foyer of City Hall. Please direct any questions you may have regarding registration, attendance, accommodation or social functions to the staff at this desk. The registration desk will be open during the following hours:

Monday 28 September	1730–1900 (Newcastle Art Gallery)
Tuesday 29 September	0800–1900
Wednesday 30 September	0800–1730
Thursday 1 October	0800–1730

The registration desk can be contacted during these hours on 0448 576 105.

Name badges

Your name badge is your entry to all sessions, exhibition, lunches and morning and afternoon teas. *Please wear it at all times.*

Catering

Morning and afternoon teas and lunches will be held in the Banquet Room, which is located on the ground floor of City Hall. Lunches will be served as an informal stand-up buffet. We have arranged for special meals to be prepared for those delegates who have pre-registered their special requirements. These meals will be available from the designated buffet stations during meal breaks. Please see a member of the banquet staff for assistance.

Program changes

The conference organisers cannot be held responsible for any program changes due to external or unforeseen circumstances. Please check the program board located outside the Concert Hall for any changes to sessions.

Speakers preparation area

A speaker preparation area is located in the Concert Hall Foyer of City Hall and will be open during the following hours:

Monday 28 September	1730–1900 (Newcastle Art Gallery)
Tuesday 29 September	0800–1900
Wednesday 30 September	0800–1730
Thursday 1 October	0800–1600

All speakers must take their presentation to the speaker preparation area a minimum of four hours prior to their presentation, or the day before if presenting at a morning session. Speakers are also requested to assemble in their session room 15 minutes before the commencement of the session, to meet with their session chair and to familiarise themselves with the room and the audiovisual equipment.

Noticeboard

A noticeboard will be maintained adjacent to the registration desk showing program changes, messages and other information. Please check the board regularly for updates.

Mobile phones

As a courtesy to speakers and other delegates, please ensure that all mobile phones are switched off during sessions.

Participant list

The participant list has been included in the conference satchel. Those delegates who have indicated on their registration form that they do not wish to have their name and organisation appear on the participant list have not been included.

General information

Useful telephone numbers

TAXIS

Newcastle Taxis 13 33 00

HOTELS

Crowne Plaza Newcastle 4907 5065
Travelodge Newcastle 4926 3777
Ibis Newcastle 4925 2266

PUBLIC TRANSPORT

Buses 13 15 00
www.newcastlebuses.info/timetables.htm

AIRLINES

Qantas 13 13 13
Virgin Blue 13 67 89
Jetstar 13 15 38
Brindabella Airlines 1300 66 88 24

Eating out in Newcastle

Newcastle has a great food scene, with eateries to suit all budgets. There are four main dining precincts to explore in the inner city:

- Darby Street in Cooks Hill (5–10 min walk from City Hall). A diverse, friendly, relaxed bohemian precinct. Darby Street has a vibrant cafe culture, and a good selection of restaurants, pubs and take away outlets.
- Honeysuckle and the Harbour waterfront (5–10 min walk from City Hall). Down at the waterfront you will find cafes, bars and restaurants, with wonderful views across the wharves. The foreshore promenade offers a great way to walk off dessert!
- Beaumont Street in Hamilton (10 min drive from City Hall). There is a strong Mediterranean focus along Beaumont Street, with many sidewalk cafes and a thriving pub-scene.
- The Junction (25 min walk / 5 min drive from City Hall). An upmarket shopping precinct with a smattering of first-class restaurants and cafes to relax in.

Dining options closest to City Hall are:

- Civic Precinct, which has a few coffee shops and sandwich bars
- Honeysuckle and Derby Street, which both have a great selection of sit-down cafes, bars and restaurants.

For further information on places to eat in Newcastle please visit www.eatlocal.com.au/.

Things to do in Newcastle

CAROLE FRAZERS WALKS AND TALKS

Discover what makes Newcastle unique and discover Newcastle's best hidden treasures with Carole Frazer's Walks and Talks. You may be surprised that Newcastle has many fascinating walks in and around Newcastle city. Included are the spectacular Bogey Hole, Leadlight Tower and historic houses, Art Gallery and cultural buildings. All walks include commentary on many city topics and especially of local Newcastle history. There are a number of different types of walks you can do catering for a diverse range of areas and interesting locations. Prices start at \$10 per person for a 1 hour tour. For more information, log onto www.walks-talks.com.au or phone Carole on 02 4952 1537

BLACKBUTT RESERVE

Blackbutt Reserve provides nature trails, wildlife exhibits, children's playgrounds and recreational facilities. It is the perfect place for a relaxing family picnic or to explore the wonders of nature. Wildlife Exhibits open 9.00 am to 5.00 pm every day of the year. Picnic and recreation facilities open from 7.00 am to 5.00 pm and entry is free. For more information log onto www.ncc.nsw.gov.au/discover_newcastle/blackbutt_reserve

NEWCASTLES FAMOUS TRAM

Everything about Newcastle's Famous Tram is unique. Built from scratch in 1994, the tram is a genuine replica of the original Newcastle working tram, which was in service in 1923. Newcastle's Famous Tram is a very novel and nostalgic way to visit the historical city of Newcastle. The Newcastle tour is a 45 minute tour of our city, beaches and historical sites. A full commentary is provided. This service in the heart of Newcastle reveals to its passengers the beauty of the city and beach areas as well as an astonishing blend of history and current changes to the city lifestyle. Detailed information is provided about many historic sites. The tour is great value at \$12 an adult and \$6 and operates weekday tours from Newcastle's Railway Station and the Crown Plaza in Wharf Road. The Tram operates at 11.00 am and 1.00 pm, with a special pick up at the Brewery Wharf Road at 12.55 pm, and during school holidays between 10.00 am 11.00 am 12 noon and 1.00 pm, but please ring to confirm operating times. No service on weekends or public holidays. For more information log onto www.famous-tram.com.au

DARBY ST PRECINCT

Conveniently situated and only 5 minutes from Newcastle Harbour and Foreshore, Darby St Precinct offers a diverse, friendly, and relaxed cosmopolitan destination. Consisting of over 20 cafes, outdoor dining and cosy retreats, including some award winning restaurants that boast the fine cuisine with friendly prices. Shoppers look out for unique fashion boutiques, art and gift galleries. You also have photography studios, home-wares, everyday living, music and professional services. For more information log onto www.darbystreet.com.au

Social program

Welcome Reception

Monday 28 September 2009
5.30 pm – 7.00 pm

Venue: Level 1, Newcastle Region Art Gallery, 1 Laman Street, Newcastle (opposite City Hall)

Dress: Conference attire/neat casual

Marking the opening of the conference, drinks and canapés will be served in the Newcastle Region Art Gallery. The welcome reception will give you the opportunity to register early and catch up with friends.

Poster, Wine and Cheese Night

Tuesday 29 September 2009
6.00 pm – 7.00 pm

Venue: Banquet Room and Concert Hall, Newcastle City Hall

Dress: Conference attire/neat casual

Cost: Included in full conference registration. \$25 for extra attendees or other registration categories. If you wish to attend, please check with the registration desk staff if there are still tickets available.

Conference Dinner

Wednesday 30 September 2009
7.00 pm (for 7.30 pm start) until late

Venue: Auditorium 1, Newcastle Panthers Club, corner King and Union Streets, Newcastle (5 minutes walk from City Hall)

Theme: Ruby—celebrating the 40th Anniversary of the APPS

Dress: Smart casual (wear something ruby)

Cost: Included in full conference registration. \$110 for extra attendees or other registration categories. If you have not indicated on your registration form that you would like to attend, please see the registration desk staff to find out if there are still places or tickets available for purchase.

It is not every day we turn 40. Come and help us celebrate our Ruby Anniversary at the Newcastle Panthers Club. You are assured of a night of great food, great wines, fun dancing and excellent company. Let's paint Newcastle Ruby.

Beach Party

Thursday 1 October 2009
6.30 pm – 10.30 pm

Venue: Newcastle Surf Life Saving Club

Dress: Casual

Cost: The cost of the Beach Party is not included in registration fees. Cost to all delegates and guests is \$55.. If you would like to attend, please check with the registration desk staff if there are still tickets available for purchase.

Coach transfer: Departs from the front of City Hall, King Street at 5.30 pm sharp and will return at 10.30 pm. Please be waiting at the front of City Hall at least 5 minutes before the scheduled departure time.



APPS ACPP DARWIN 2011

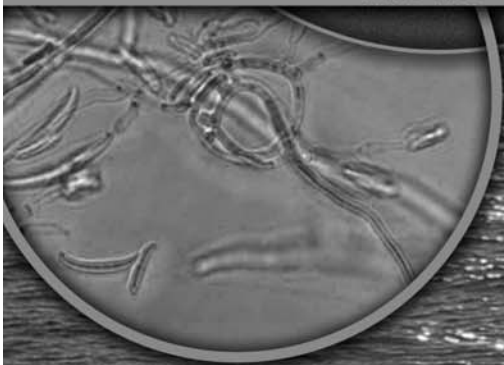
New Frontiers in Plant Pathology
for Asia and Oceania

27-29 April 2011

Darwin Convention Centre

DARWIN, NT

18th BIENNIAL AUSTRALASIAN PLANT PATHOLOGY CONFERENCE
AND THE 4th ASIAN CONFERENCE ON PLANT PATHOLOGY



The McAlpine lecture

The invitation to present the McAlpine lecture to the biennial conference of the Australasian Plant Pathology Society is extended to an eminent scientist in recognition of their significant contribution to Australasian plant pathology. The lecture is named after Daniel McAlpine, considered to be the father of plant pathology in the Australasian region. His most notable contributions were to study wheat rust following the 1889 epidemic, to classify and describe Australian smuts, and to recognise *Ophiobolus graminis* (now *Gaeumannomyces graminis*) as the cause of wheat take-all. He also collaborated with Farrer on resistance to rust in wheat (John Randles 1994, Stanislaus Fish 1976). Daniel McAlpine also contributed extensively to vegetable pathology. It is therefore fitting that a plant pathologist with extensive experience and passion such as Phil Keane be asked to deliver the McAlpine lecture in 2009.

- 1976 Dr Lilian Fraser, Department of Agriculture, NSW
Disease of citrus trees in Australia—the first hundred years
- 1978 Dr David Griffin, Australian National University, ACT
Looking ahead
- 1980 Mr John Walker, Department of Agriculture, NSW
Taxonomy, specimens and plant disease
- 1982 Professor Richard Matthews, The University of Auckland, NZ
Relationships between plant pathology and molecular biology
- 1984 Professor Bob McIntosh, University of Sydney, NSW, and Dr Colin Wellings, Department of Agriculture, NSW
Wheat rust resistance: the continuing challenge
- 1986 Dr Allen Kerr, Waite Agricultural Research Institute, SA
Agrobacterium: pathogen, genetic engineer and biological control agent
- 1989 Dr Albert Rovira, CSIRO Division of Soils, SA
Ecology, epidemiology and control of take-all, rhizotomies bare patch and cereal cyst nematode in wheat
- 1991 Mr John Walker, Department of Agriculture, NSW
Plants, diseases and pathologists in Australasia—a personal view
- 1993 Dr John Randles (University of Adelaide, SA)
Plant viruses, viroids and virologists of Australasia
- 1995 Dr Ron Close, Lincoln University, NZ
The ever changing challenges of plant pathology
- 1997 Professor John Irwin, CRC Tropical Plant Pathology, Qld
Biology and management of Phytophthora spp. attacking field crops in Australia
- 1999 Dr Dorothy Shaw, Department of Primary Industries, Qld
Bees and fungi with special reference to certain plant pathogens
- 2001 Dr Alan Dube, South Australian Research and Development Institute, SA
Long-term careers in plant pathology
- 2003 Dr Mike Wingfield, University of Pretoria, South Africa
Increasing threat of disease to exotic plantation forests in the southern hemisphere
- 2005 Dr Gretna Weste, University of Melbourne, Vic
A long and varied fungal foray

- 2007 Dr Graham Stirling, Biological Crop Protection, Qld
The impact of farming systems on soil biology and soil-borne diseases: examples from the Australian sugar and vegetable industries, the case for better integration of sugarcane and vegetable production and implications for future research
- 2009 Assoc Prof Phil Keane, La Trobe University, Vic
Lessons from the tropics—the unfolding mystery of vascular-streak dieback of cocoa, the importance of genetic diversity, horizontal resistance, and the plight of farmers

McAlpine lecturer 2009: Philip Keane



Philip grew up in the wheat/sheep belt of rural South Australia and gained his Bachelor of Agricultural Science (Hons) at the Waite Agricultural Research Institute, University of Adelaide in 1968.

He was awarded a PhD at the University of Papua New Guinea in 1972 for his studies of vascular-streak dieback, a serious epidemic disease of cocoa. He described and named the pathogen, *Oncobasidium theobromae*,

and remains the world authority on what is a particularly unusual vascular wilt disease. Not only was the pathogen a new species, but also a new genus within the Basidiomycetes.

Philip taught at UPNG before taking up a lectureship at La Trobe University in 1975. His time at La Trobe has been supplemented with sabbatical periods in the USA and Central America, as well as extensive project-related travel through PNG and Indonesia.

Since returning to Australia in 1975 Philip maintained his interest in diseases of cocoa in South East Asia and Papua New Guinea, and in agricultural development and education in tropical countries. His approach is focussed on the farmer—from listening to farmers, evaluating their ideas, then translating his research to be used by the farmers. Philip also initiated research into fungal diseases of crop plants and eucalypts, and co-edited the standard monograph on Eucalypt Pathogens and Diseases. He is involved in research on a range of big questions in plant pathology, including the nature of resistance to crop diseases, especially cereal rusts, plant disease epidemiology, the diversity of macrofungi and broad questions in plant ecology.

Philip is an enthusiastic undergraduate teacher and has trained many local and international PhD students, many of whom will be attending this conference. He has made a special and unique contribution to plant pathology in Australia and neighbouring countries, and it is a great honour that he has accepted our invitation to present the McAlpine Lecture.

Keynote biographies

Barbara Christ

Professor Barbara Christ, the current President of the American Phytopathological Society, is Senior Associate Dean in the College of Agricultural Sciences and Professor of Plant Pathology at Pennsylvania State University in the United States. Her research is focused on potato breeding and disease management, including basic research into understanding the inheritance of disease resistance as well as extension. Her research includes developing and releasing new varieties adapted for Pennsylvania growing conditions, developing disease-resistant potato germplasm, examining the genetic variability and biology of potato pathogen populations, developing methods to detect and forecast potato diseases, developing integrated pest management strategies for potatoes in Pennsylvania, and evaluating new fungicides for efficacy against potato diseases.

André Drenth

Dr André Drenth is a Principal Plant Pathologist from the University of Queensland, and founder and Leader of the Tree Pathology Centre which is a joint initiative between the University of Queensland and Queensland Primary Industries and Fisheries. André studied Plant Breeding and Pathology at Wageningen University and Cornell University, USA. André was Research Program Leader in the CRC for Tropical Plant Protection dealing with a large number of Tropical diseases. His ability to deliver practical outcomes from basic research in plant pathology is well recognised internationally. André has been involved in research on plant pathogens for nearly 20 years and has published widely on a range of plant diseases with a special focus on *Phytophthora*.

Adrienne Hardham

Professor Adrienne Hardham works in the Research School of Biology at the Australian National University. The main focus of her research is on cellular and molecular mechanisms responsible for the infection of plants by *Phytophthora* and rust fungi and the plant's defence response to pathogen invasion.

Greg Johnson

Dr Greg Johnson is President of the Australasian Plant Pathology Society (APPS) 2007–2009 and Secretary General of the International Society for Plant Pathology (ISPP) 2006–2013. Greg has had over 20 years' experience in development assistance in tropical horticulture and postharvest R&D collaboration with developing countries in Asia and the Pacific, and over 30 years' experience in plant pathology practice, diagnostic advice and publishing on tropical and temperate plants and crops. His especial interest is postharvest diseases of mangoes. Greg currently operates a Canberra-based consultancy, Horticulture 4 Development, that builds upon Greg's background in managing a portfolio of projects and activities in postharvest technology, horticulture and crop protection with the Australian Centre for International Agricultural Research (ACIAR) in Asia and the Pacific. His recent activities have included an overview of the vegetable sector in tropical Asia and reviewing issues and priorities for postharvest disease management in mangoes.

Celeste Linde

Celeste Linde investigates the population genetics of, for example, cereal pathogens, the influence of wild or weedy hosts on pathogen populations and their evolution of virulence. Her main focus has been with *Rhynchosporium secalis*, causing barley scald.

Eun Woo Park

Professor Eun Woo Park is Dean of the College of Agriculture and Life Sciences in Seoul National University, Korea. Major research areas are epidemiology of airborne diseases with special emphasis on modeling and forecasting disease development, and applications of various information technologies to implement disease management strategies.

Dov Prusky

Professor Dov Prusky is Deputy Director Research and Development with the Agricultural Research Organization, Israel. He is also active in research in the Department of Postharvest Science of Fresh Produce of the ARO Technology and Storage of Agricultural Products Institute. Dov is currently Chair of the ISPP Postharvest Diseases Subject Matter committee. Dov's research interests include:

- understanding the basic processes underlying the interactions between fruits and pathogenic fungi
- studying biochemical and molecular mechanisms that are controlled by fungal virulence and fruit resistance factors
- using transformation-mediated gene disruption to create strains of pathogenic fungi that are specifically mutated in their ability to make cell-wall degrading enzymes and other pathogenicity factors. These mutants are tested for their ability to cause disease and to elicit defense responses
- studying the biochemical basis for modulation of pathogenicity factor affecting the transcription expression of nitrogen metabolism, ammonia secretion and the effect on the modulation of local pH
- reduction of postharvest losses in deciduous and subtropical fruits.

Robert Seem

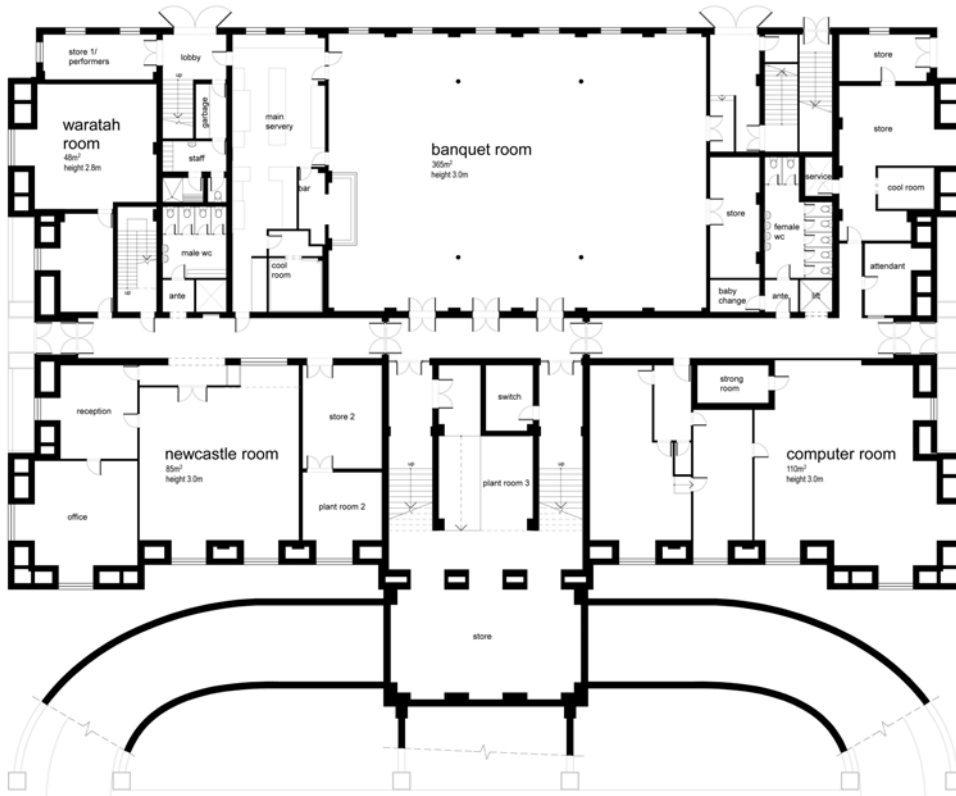
Robert C Seem has spent his 34-year career as professor of plant pathology at Cornell University's Agricultural Experiment Station in Geneva, New York. He specialises in the epidemiology of fruit and vegetable diseases. Robert also served in the station administration for 14 years. During this time he was instrumental in the development of the Cornell Agriculture and Food Technology Park Corporation, where he continues to serve a president of the board.

Mike Wingfield

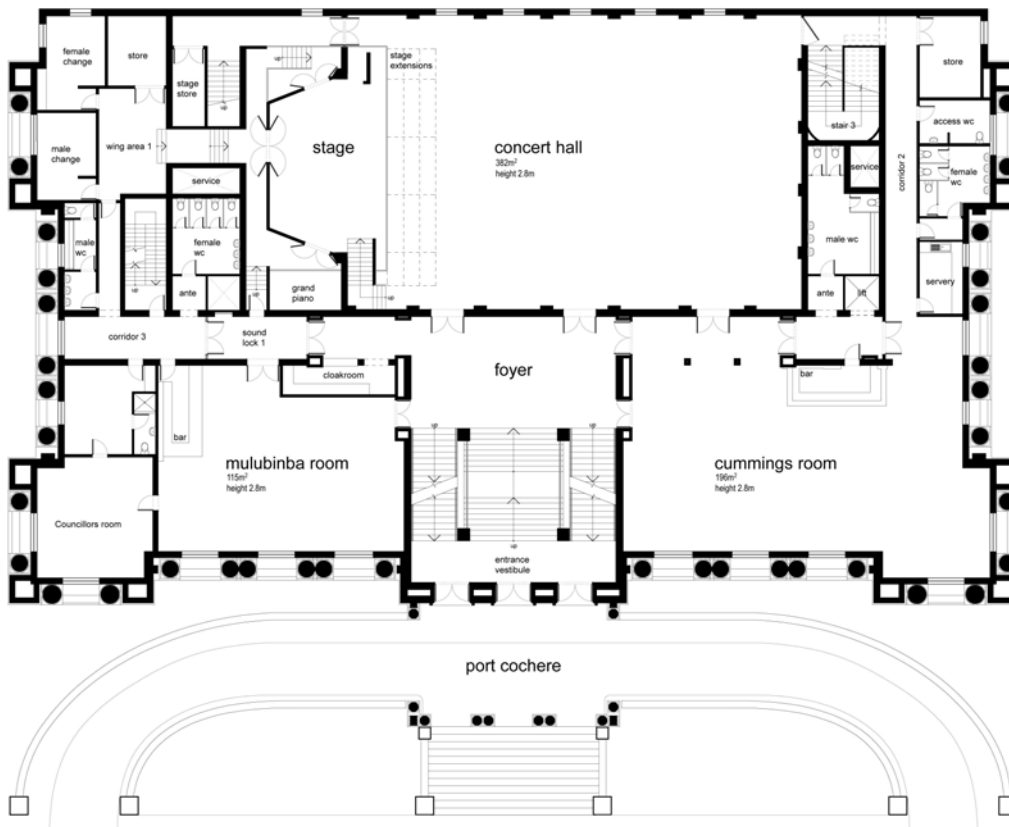
Professor Michael Wingfield was born in South Africa. He graduated with BSc Hons (Natal) and MSc (Stellenbosch) degrees then completed his PhD in Plant Pathology (University of Minnesota), specialising in forest pathology and forest entomology. He returned to South Africa to establish the Tree Protection Co-operative Programme (TPCP) at the University of the Free State, and in 1998 established the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria. FABI is now the Centre of Excellence in Tree Health Biotechnology. He is also an alumnus of the Harvard Business School Advanced Management Programme.

Venue map

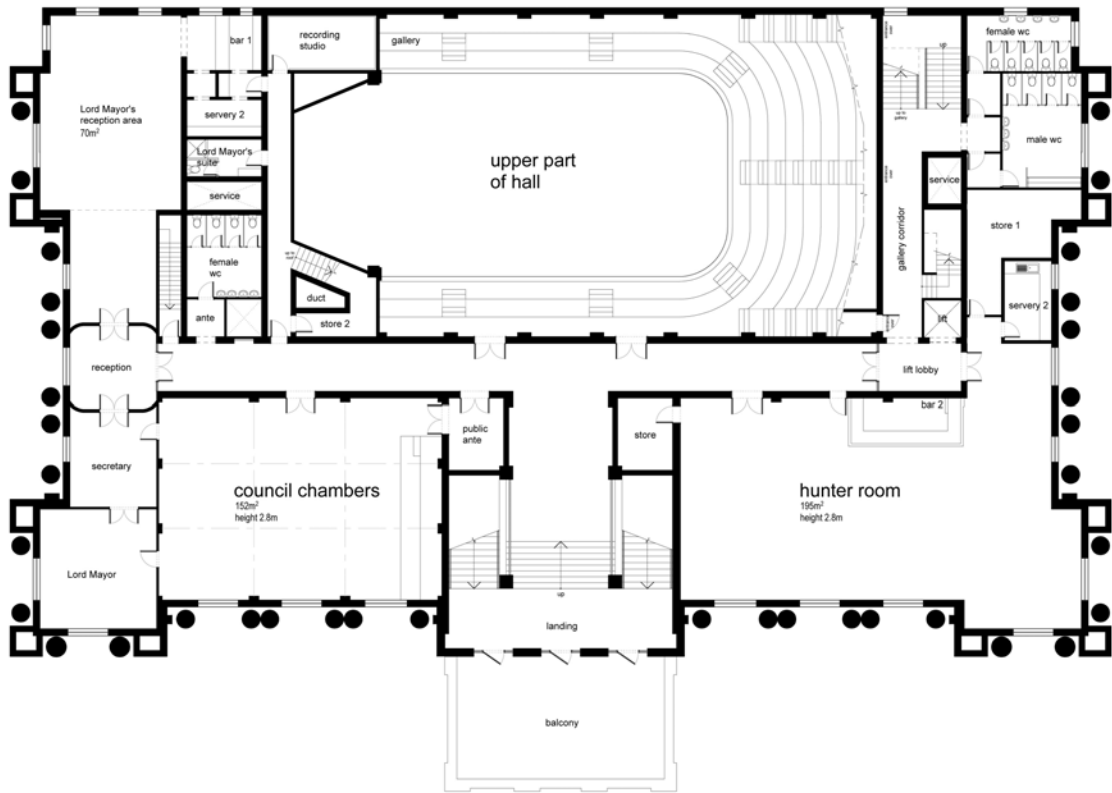
Level 1



Level 2



Level 3



Program

Monday 28 September

1400–1700	Registration open	Ground Floor Foyer, Newcastle Region Art Gallery
1730–1800	WELCOME RECEPTION	Newcastle Region Art Gallery



Tuesday 29 September


0800–1900	Registration open	Concert Hall Foyer																
0800	ARRIVAL TEA AND COFFEE	Concert Hall Foyer																
0830	Conference opening Prof David Guest , University of Sydney	Concert Hall																
0845	Presidential address— <i>‘Shield the young harvest from devouring blight’—Charles Darwin, Joseph Banks, Thomas Knight and wheat rust: discovery, adventure, and ‘getting the message out’</i> Dr Greg Johnson , Horticulture 4 Development, ACT	Concert Hall																
0930	Keynote address— <i>The relevance of plant pathology in food production</i> Dr André Drenth , Tree Pathology Centre, The University of Queensland and Primary Industries and Fisheries	Concert Hall																
1030	MORNING TEA	Banquet Room																
	<table border="1"> <thead> <tr> <th>Session 1A Disease management Room: Concert Hall Chair: Andrew Miles</th> <th>Session 1B Disease surveys Room: Cummings Room Chair: Eileen Scott</th> <th>Session 1C Soilborne diseases Room: Hunter Room Chair: Nerida Donovan</th> <th>Session 1D Virology Room: Newcastle Room Chair: John Randles</th> </tr> </thead> <tbody> <tr> <td>1100 <i>An integrated approach to husk spot management in macadamia</i> Dr Olufemi Akinsanmi, The University of Queensland and Primary Industries and Fisheries, Qld</td> <td><i>Why Australia needs a coordinated national diagnostic system</i> Ms Jane Moran, Department of Primary Industries, Vic</td> <td><i>Can investment in building up soil organic carbon lead to disease suppression in vegetable crops?</i> Dr Ian Porter, Department of Primary Industries, Vic</td> <td><i>Towards universal detection of Luteoviridae</i> Miss Anastasija Chomic, Lincoln University, NZ</td> </tr> <tr> <td>1120 <i>Application methods of phosphonate to control Phytophthora pod rot and stem canker on cocoa</i> Dr Peter McMahan, La Trobe University, Vic</td> <td><i>Development of a soil DNA extraction and quantitative PCR method for detecting two Cylindrocarpon species in soil</i> Ms Chantal Probst, Lincoln University, NZ</td> <td><i>Evaluation of soil health indicators in the vegetable industry of temperate Australia</i> Ms Robyn Brett, Department of Primary Industries, Vic</td> <td><i>Massive parallel sequencing of small RNAs to identify plant viruses and virus-induced small RNAs</i> Dr Robin MacDiarmid, The New Zealand Institute for Plant and Food Research Ltd, NZ</td> </tr> <tr> <td>1140 <i>Botrytis bunch rot control strategies in cool climate viticultural regions of Australia and New Zealand</i> Dr Jacqueline Edwards, Department of Primary Industries, Vic</td> <td><i>Bananas in Carnarvon—good news for growers in survey for quarantine plant pests and pathogens</i> Dr Sarah Collins, Department of Agriculture and Food WA</td> <td><i>Rhizoctonia AG2.1 and AG3 in soil—competition or synergism?</i> Dr Tonya Wiechel, Department of Primary Industries, Vic</td> <td><i>Chickpea chlorotic stunt virus, an important virus of cool-season food legumes in Asia and North Africa and potentially in Australia</i> Dr Safaa Kumari, International Center for Agricultural Research in the Dry Areas, Syria</td> </tr> </tbody> </table>	Session 1A Disease management Room: Concert Hall Chair: Andrew Miles	Session 1B Disease surveys Room: Cummings Room Chair: Eileen Scott	Session 1C Soilborne diseases Room: Hunter Room Chair: Nerida Donovan	Session 1D Virology Room: Newcastle Room Chair: John Randles	1100 <i>An integrated approach to husk spot management in macadamia</i> Dr Olufemi Akinsanmi , The University of Queensland and Primary Industries and Fisheries, Qld	<i>Why Australia needs a coordinated national diagnostic system</i> Ms Jane Moran , Department of Primary Industries, Vic	<i>Can investment in building up soil organic carbon lead to disease suppression in vegetable crops?</i> Dr Ian Porter , Department of Primary Industries, Vic	<i>Towards universal detection of Luteoviridae</i> Miss Anastasija Chomic , Lincoln University, NZ	1120 <i>Application methods of phosphonate to control Phytophthora pod rot and stem canker on cocoa</i> Dr Peter McMahan , La Trobe University, Vic	<i>Development of a soil DNA extraction and quantitative PCR method for detecting two Cylindrocarpon species in soil</i> Ms Chantal Probst , Lincoln University, NZ	<i>Evaluation of soil health indicators in the vegetable industry of temperate Australia</i> Ms Robyn Brett , Department of Primary Industries, Vic	<i>Massive parallel sequencing of small RNAs to identify plant viruses and virus-induced small RNAs</i> Dr Robin MacDiarmid , The New Zealand Institute for Plant and Food Research Ltd, NZ	1140 <i>Botrytis bunch rot control strategies in cool climate viticultural regions of Australia and New Zealand</i> Dr Jacqueline Edwards , Department of Primary Industries, Vic	<i>Bananas in Carnarvon—good news for growers in survey for quarantine plant pests and pathogens</i> Dr Sarah Collins , Department of Agriculture and Food WA	<i>Rhizoctonia AG2.1 and AG3 in soil—competition or synergism?</i> Dr Tonya Wiechel , Department of Primary Industries, Vic	<i>Chickpea chlorotic stunt virus, an important virus of cool-season food legumes in Asia and North Africa and potentially in Australia</i> Dr Safaa Kumari , International Center for Agricultural Research in the Dry Areas, Syria	
Session 1A Disease management Room: Concert Hall Chair: Andrew Miles	Session 1B Disease surveys Room: Cummings Room Chair: Eileen Scott	Session 1C Soilborne diseases Room: Hunter Room Chair: Nerida Donovan	Session 1D Virology Room: Newcastle Room Chair: John Randles															
1100 <i>An integrated approach to husk spot management in macadamia</i> Dr Olufemi Akinsanmi , The University of Queensland and Primary Industries and Fisheries, Qld	<i>Why Australia needs a coordinated national diagnostic system</i> Ms Jane Moran , Department of Primary Industries, Vic	<i>Can investment in building up soil organic carbon lead to disease suppression in vegetable crops?</i> Dr Ian Porter , Department of Primary Industries, Vic	<i>Towards universal detection of Luteoviridae</i> Miss Anastasija Chomic , Lincoln University, NZ															
1120 <i>Application methods of phosphonate to control Phytophthora pod rot and stem canker on cocoa</i> Dr Peter McMahan , La Trobe University, Vic	<i>Development of a soil DNA extraction and quantitative PCR method for detecting two Cylindrocarpon species in soil</i> Ms Chantal Probst , Lincoln University, NZ	<i>Evaluation of soil health indicators in the vegetable industry of temperate Australia</i> Ms Robyn Brett , Department of Primary Industries, Vic	<i>Massive parallel sequencing of small RNAs to identify plant viruses and virus-induced small RNAs</i> Dr Robin MacDiarmid , The New Zealand Institute for Plant and Food Research Ltd, NZ															
1140 <i>Botrytis bunch rot control strategies in cool climate viticultural regions of Australia and New Zealand</i> Dr Jacqueline Edwards , Department of Primary Industries, Vic	<i>Bananas in Carnarvon—good news for growers in survey for quarantine plant pests and pathogens</i> Dr Sarah Collins , Department of Agriculture and Food WA	<i>Rhizoctonia AG2.1 and AG3 in soil—competition or synergism?</i> Dr Tonya Wiechel , Department of Primary Industries, Vic	<i>Chickpea chlorotic stunt virus, an important virus of cool-season food legumes in Asia and North Africa and potentially in Australia</i> Dr Safaa Kumari , International Center for Agricultural Research in the Dry Areas, Syria															
1200	LUNCH Editor’s meeting (1200–1400) Student mentor lunch (1200–1320)	Banquet Room Waratah Room Mulumbinba Room																
1320	Keynote address— <i>Emerging frontiers in forest pathology</i> Prof Mike Wingfield , Forestry and Agricultural Biotechnology Institute, University of Pretoria, South Africa	Concert Hall																



	Session 2A Forest pathology/native Room: Concert Hall Chair: Angus Carnegie	Session 2B Soilborne disease Room: Cummings Room Chair: Peter McGee	Session 2C Epidemiology Room: Hunter Room Chair: Chris Steel	Session 2D Disease management Room: Newcastle Room Chair: Robert Magarey
1410	<i>Variability in pathogenicity of Quambalaria pitereka on spotted gums</i> Mr Geoffrey Pegg , The University of Queensland/ Primary Industries and Fisheries, Qld	<i>Optimising conditions to investigate gene expression in pathogenic Streptomyces using RT-qPCR</i> Dr Tonya Wiechel , Department of Primary Industries, Vic	<i>Bunch rot diseases and their management</i> Prof Turner Sutton , NC State University, USA	<i>Sugarcane smut—disease development and mechanism of resistance</i> Dr Shamsul Bhuiyan , BSES Limited, Qld
1430	<i>Movement of pathogens between horticultural crops and endemic trees in the Kimberleys</i> Ms Monique Sakalidis , Murdoch University, WA	<i>Fusarium oxysporum and Pythium associated with vascular wilt and root rots of greenhouse cucumbers</i> Mr Len Tesoriero , NSW Department of Primary Industries	<i>Inoculum and climatic factors driving epidemics of Botrytis cinerea in New Zealand and Australian vineyards</i> Dr Rob Beresford , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>Dissemination of biological and chemical fungicides by bees onto Rubus and Ribes flowers</i> Dr Monika Walter , The New Zealand Institute for Plant and Food Research Limited, NZ
1450	<i>Pathogenicity of Phytophthora multivora to Eucalyptus gomphocephala and E. marginata</i> Dr Treena Burgess , Murdoch University, WA	<i>Fusarium oxysporum f. sp. fragariae: a main component of strawberry crown and root rots in Western Australia</i> Dr Hossein Golzar , Department of Agriculture and Food WA	<i>Infection of apples by Colletotrichum acutatum in New Zealand is limited by temperature</i> Dr Kerry Everett , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>Current studies on divergence and management of pepper yellow leaf curl disease Indonesia</i> Dr Sri Hidayat , Bogor Agricultural University, Indonesia
1510	<i>Microscopy of progressive decay of fungi isolated from Meranti tree canker</i> Dr Erwin Erwin , University of Mulawarman, Indonesia	<i>Evaluation of resistant rootstocks for control of Fusarium wilt of watermelon in Nghe An Province, Vietnam.</i> Prof Lester Burgess , The University of Sydney, NSW	<i>Epidemiology of walnut blight, caused by Xanthomonas arboricola pv. juglandis, in Tasmania, Australia</i> Dr Katherine Evans , University of Tasmania	<i>Fungicide resistance in cucurbit powdery mildew</i> Dr Chrys Akem , Primary Industries and Fisheries, Qld
1530	AFTERNOON TEA			Banquet Room
1600	Keynote address— <i>Population genetic analyses of plant pathogens: new challenges and opportunities</i> Dr Celeste Linde , Research School of Biology, College of Medicine, Biology and Environment, Australian National University			Concert Hall
	Session 3A Population genetics Room: Concert Hall Chair: Andre Drenth	Session 3B Modelling and crop loss assessment Room: Cummings Room Chair: Ian Porter	Session 3C Disease management Room: Hunter Room Chair: Shane Hetherington	
1640	<i>Genetic diversity of Botryosphaeria parva (Neofusicoccum parvum) in New Zealand vineyards</i> Mr Jeyaseelan Baskarathevan , Lincoln University, NZ	<i>Spore traps for early warning of smut infestations in Australian sugarcane crops</i> Dr Rob Magarey , BSES Limited, Qld	<i>Management of white blister on vegetable brassicas with irrigation and varieties</i> Dr Elizabeth Minchinton , Department of Primary Industries, Vic	
1700	<i>Anthraxnose disease of chili pepper—genetic diversity, pathogenicity and breeding for resistance</i> A/Prof Paul Taylor , The University of Melbourne, Vic	<i>Software-assisted gap estimation (SAGE) for measuring grapevine leaf canopy density</i> Mr Gareth Hill , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>Alternative screening methods for sugarcane smut using natural infection and tissue staining</i> Dr Shamsul Bhuiyan , BSES Limited, Qld	
1720	<i>The diversity of Colletotrichum infecting lychee in Australia</i> Ms Jay Anderson , Primary Industries and Fisheries, Qld and University of Queensland	<i>Evaluation of the efficacy of Brassica_{spot}TM models for control of white blister in Chinese cabbage</i> Mr Desmond Auer , Department of Primary Industries, Vic	<i>Interruption of cool chain and strawberry fruit rot by leak-causing fungi Rhizopus species</i> Dr Monika Walter , The New Zealand Institute for Plant and Food Research Limited, NZ	
1740	<i>Variation in Phytophthora palmivora on cocoa in Papua New Guinea</i> Ms Josephine Saul Maora , PNG Cocoa Coconut Institute	<i>Evaluating an infection model of prune rust to improve the management of disease for almond and prune growers</i> Mr Peter Magarey , South Australian Research and Development Institute	<i>Enhancing Papua New Guinea smallholder cocoa production through greater adoption of integrated pest and disease management</i> Mr Yak Namaliu , PNG Cocoa Coconut Institute	
1800	DRINKS AND POSTERS			Banquet Room and Concert Hall
1830–2030	Council of Society meeting			Waratah Room

Wednesday 30 September

0800–1730	Registration open	Concert Hall Foyer	
0800	ARRIVAL TEA AND COFFEE	Concert Hall Foyer	
0830	Keynote address— <i>Molecular cytology of Phytophthora-plant interactions</i> Prof Adrienne Hardham , Plant Cell Biology Group, Research School of Biology, The Australian National University	Concert Hall	
	Session 4A Plant pathogen interactions Room: Concert Hall Chair: David Guest	Session 4B Disease surveys Room: Cummings Room Chair: Sandra Savocchia	Session 4C Epidemiology Room: Hunter Room Chair: Greg Johnson
	Session 4D Prokaryotic pathogens Room: Newcastle Room Chair: Lucy Tran-Nguyen		
0910	<i>Gene expression changes during host-pathogen interaction between Arabidopsis thaliana and Plasmodiophora brassicae</i> Mrs Arati Agarwal , Department of Primary Industries, Vic	<i>Prevalence and pathogenicity of Botryosphaeria lutea isolated from grapevine nursery materials in New Zealand</i> Ms Regina Billones , Lincoln University, NZ	<i>Honey bees— do they aid the dispersal of Alternaria radicina in carrot seed crops?</i> Mr Rajan Trivedi , Lincoln University, NZ
0930	<i>Hairpin RNA derived from viral Nla gene confers immunity to wheat streak mosaic virus infection in transgenic wheat plants</i> Mr Muhammad Fahim , CSIRO Plant Industry, and Australian National University, ACT	<i>Infection and disease progression of Neofusicoccum luteum in grapevine plants</i> Mr Nicholas Amponsah , Lincoln University, NZ	<i>Translating research into the field: meta-analysis of field pea blackspot severity and yield loss to extend model application for disease management in Western Australia</i> Dr Moin Salam , Department of Agriculture and Food WA
0950	<i>Characterising inositol signalling pathways in Phytophthora spp. for future development of selective antibiotics</i> Mr Dean Phillips , Deakin University, Vic	<i>Carbohydrate stress increases susceptibility of grapevines to Cylandrocarpon black foot disease</i> Miss Dalin Dore , Lincoln University, NZ	<i>Development of a model to predict spread of exotic wind and rain borne fungal pests</i> Dr Moin Salam , Department of Agriculture and Food WA
1010	<i>Systemic acquired resistance— a new addition to the IPM clubroot toolbox?</i> Dr Caroline Donald , Department of Primary Industries, Vic	<i>Botryosphaeria spp. associated with bunch rot of grapevines in south-eastern Australia</i> Ms Nicola Wunderlich , Charles Sturt University, NSW	<i>Psyllid transmission of Huanglongbing from naturally infected Shogun mandarin to orange jasmine</i> Dr Rantana Sdoodee , Prince of Songkla University, Thailand
1030	MORNING TEA	Banquet Room	
1100	Keynote address— <i>Mechanisms modulating fungal attack in postharvest pathogen interactions and their modulation for improved disease control</i> Prof Dov Prusky , Department of Postharvest Science of Fresh Produce, Agricultural Research Organization, Israel	Concert Hall	
	Session 5A Plant pathogen interactions Room: Concert Hall Chair: Rosalie Daniel	Session 5B Disease surveys Room: Cummings Room Chair: Aaron Maxwell	Session 5C Chemical control Room: Hunter Room Chair: Len Tesoriero
1140	<i>ABA-dependant signalling of PR genes and potential involvement in the defence of lentil to Ascochyta lentis</i> Dr Rebecca Ford , The University of Melbourne, Vic	<i>Fishing For Phytophthora across Western Australia's water bodies</i> Dr Daniel Hüberli , Murdoch University, WA	<i>Evaluation of fungicides to manage brassica stem canker</i> Ms Lynette Deland , South Australian Research and Development Institute, SA
1200	<i>Fundamental components of resistance to Phytophthora cinnamomi: using model system approaches</i> Prof David Cahill , Deakin University, Vic	<i>Incidence of fungi isolated from grape trunks in New Zealand vineyards</i> Mr Dion Mundy , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>Evaluation of spray programs for powdery mildew management in greenhouse cucumbers</i> Dr Kaye Ferguson , South Australian Research and Development Institute, SA
1220	<i>Genes involved in hypersensitive cell death responses during Fusarium crown rot infection in wheat</i> Dr Jill Petrisko , University of Southern Queensland, Qld	<i>Isolation and characterisation of strains of Pseudomonas syringae from waterways of the Central North Island of New Zealand</i> Dr Joel Vanneste , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>The incidence of copper resistant bacteria in Australian pome and stone fruit orchards</i> Dr Chin Gouk , Department of Primary Industries, Vic

1240	AGRICHEM LUNCH		Banquet Room
1340	Poster session		Banquet Room and Concert Hall
1430	AFTERNOON TEA		Banquet Room
1500	McAlpine lecture— <i>Lessons from the tropics—the unfolding mystery of vascular-streak dieback of cocoa, the importance of genetic diversity, horizontal resistance, and the plight of farmers</i> Assoc Prof Phil Keane , Department of Botany, La Trobe University, Vic		Concert Hall
1600	AGM		Concert Hall
1730	Close of day		
1900	CONFERENCE DINNER		Newcastle Panthers Club

Thursday 1 October

0700	Regional Councillor's meeting	Waratah Room	
0700	CHAIRMAN'S BREAKFAST	Mulumbinba Room	
0800–1730	Registration open	Concert Hall Foyer	
0800	ARRIVAL TEA AND COFFEE	Concert Hall Foyer	
0830	Keynote address— <i>Translating research into the field: how it started, how it is practised and how we carry out grape powdery mildew research</i> Dr Bob Seem , Cornell University, USA	Concert Hall	
0910	GRDC book launch: Mr James Clarke , Grains Research and Development Corporation	Concert Hall	
	Session 6A Cereal pathology 1 Room: Concert Hall Chair: Mark Sutherland	Session 6B Quarantine and exotic pathogens Room: Cummings Room Chair: Suzy Perry	Session 6C Alternatives to chemical control Room: Hunter Room Chair: Carolyn Blomley
0925	<i>Stem rust race Ug99: international perspectives and implications for Australia</i> Dr Colin Wellings , The University of Sydney, NSW	<i>Development of an eradication strategy for exotic grapevine pathogens</i> Dr Mark Sosnowski , South Australian Research and Development Institute, SA	<i>The influence of soil biotic factors on the ecology of Trichoderma biological control agents</i> Prof Alison Stewart , Lincoln University, NZ
0945	<i>Mitigating crop losses due to stripe rust in Australia: integrating pathogen population dynamics with research and extension programs</i> Dr Colin Wellings , The University of Sydney, NSW	<i>Green grassy shoot disease of sugarcane, a major disease in Nghe An Province, Vietnam</i> Dr Rob Magarey , BSES Limited, Qld	<i>Understanding Trichoderma bio-inoculants in the root system of Pinus radiata</i> Mr Pierre Hohmann , Lincoln University, NZ
1005	<i>Impact of sowing date on crown rot losses</i> Dr Steven Simpfendorfer , Department of Primary Industries, NSW	<i>Molecular detection of Mycosphaerella fijiensis in the leaf trash of 'Cavendish' banana</i> Dr Seona Casonato , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>A bioassay to screen Trichoderma isolates for their ability to promote root growth in willow</i> Mr Mark Braithwaite , Lincoln University, NZ
1025	<i>Symptom development and pathogen spread in wheat genotypes with varying levels of crown rot resistance</i> Dr Cassandra Malligan , Queensland Primary Industries and Fisheries	<i>Optimising responses to incursions of exotic plant pathogens</i> Dr Mike Hodda , CSIRO Entomology, ACT	<i>Biofumigation for reducing Cyldrocarpon spp. in New Zealand vineyard and nursery soil</i> Ms Carolyn Bleach , Lincoln University, NZ
1045	MORNING TEA	Banquet Room	
	Session 7A Cereal pathology 2 Room: Concert Hall Chair: Colin Wellings	Session 7B Quarantine and exotic pathogens Room: Cummings Room Chair: Nerida Donovan	Session 7C Alternatives to chemical control Room: Hunter Room Chair: Alison Stewart
1100	<i>Crown rot of winter cereals: integrating molecular studies and germplasm improvement</i> Prof Mark Sutherland , University of Southern Queensland, Qld	<i>Twenty years of quarantine plant disease surveillance on the island of New Guinea: key discoveries for Australia and PNG</i> Mr Richard Davis , Australian Quarantine and Inspection Service, Qld	<i>Fruit extracts of Azadirachta indica induces systemic acquired resistance in tomato against Pseudomonas syringae pv tomato</i> Dr Prabir Paul , Amity University, India
1120	<i>Infection of wheat tissues by Fusarium pseudograminearum</i> Mr Noel Knight , University of Southern Queensland, Qld	<i>The importance of reporting suspect exotic or emergency plant pests to your State</i> <i>Department of Primary Industry</i> Dr Sophie Peterson , Plant Health Australia, ACT	<i>Fungal foliar endophytes induce systemic protection in cacao seedlings against Phytophthora palmivora</i> Ms Carolyn Blomley , The University of Sydney, NSW
1140	<i>Monitoring sensitivity to Strobilurin fungicides in Blumeria graminis on wheat and barley in Canterbury, New Zealand</i> Dr Suvi Viljanen-Rollinson , The New Zealand Institute for Plant and Food Research Limited, NZ	<i>The use of sentinel plantings in forest biosecurity; results from mixed eucalypt species trails in South-East Asia and Australia</i> Dr Treena Burgess , Murdoch University, WA	<i>Effectiveness of the rust Puccinia myrsiphylli in reducing populations of the invasive plant bridal creeper in Australia</i> Dr Louise Morin , CSIRO Entomology, ACT
1200	<i>Cross inoculation of crown rot and Fusarium head blight isolates of wheat</i> Mr Philip Davies , University of Sydney, NSW	<i>Methyl bromide alternatives for quarantine and pre-shipment and other purposes—future perspectives</i> Ms Janice Oliver , Office of the Chief Plant Protection Officer, ACT	<i>Evaluation of essential oils and other plant extracts for control of soilborne pathogens of vegetable crops</i> Ms Cassie Scoble , Department of Primary Industries and La Trobe University, Vic
1230	LUNCH	Banquet Room	

1330	Keynote address— <i>Use of grid weather forecast data to predict rice blast development in Korea</i> Prof Eun Woo Park , College of Agriculture and Life Sciences, Seoul National University, Korea	Concert Hall
1410	<i>Investigating the impact of climate change on plant diseases</i> Dr Jo Luck , Department of Primary Industries, Vic	
1430	<i>Impact of climate change in relation to blackleg on oilseed rape and blackspot on field pea in Western Australia</i> Dr Moin Salam , Department of Agriculture and Food, WA	
1450	<i>Approaches to training in plant pathology capacity building projects in developing countries</i> Prof LW Burgess , University of Sydney, NSW	
1510	<i>Increasing global regulations on fumigants stimulates new era for plant protection and biosecurity</i> Dr Ian Porter , Department of Primary Industries, Vic	
1530	AFTERNOON TEA	Banquet Room
1600	Keynote address— <i>A world of possibilities</i> Dr Barbara Christ , The Pennsylvania State University, USA	Concert Hall
1630	Incoming presidential address Dr Caroline Mohammed , School of Agricultural Science, University of Tasmania	
1645	Awards	
1700	Close of day	
1730	Bus leaves Civic Centre for Beach Party	
1800	BEACH PARTY	Newcastle Surf Life Saving Club

Oral abstracts

Genes involved in hypersensitive cell death responses during *Fusarium* crown rot infection in wheat

Jill E. Petrisko¹ XE "Petrisko, J.E." ¹, Mark W. Sutherland¹, Juliet M. Windes²

¹Centre for Systems Biology, University of Southern Queensland, Toowoomba, Queensland, 4350, Australia

²University of Idaho, Plant, Soils, and Entomological Sciences, University Place, 1776 Science Center Drive, Suite 205, Idaho Falls, Idaho 83402

INTRODUCTION

Hypersensitive plant cell death is activated by the accumulation of hydrogen peroxide and nitric oxide (1), and is strictly controlled by several genes including cysteine proteases, hydrogen peroxide and superoxide scavengers, and cell death regulators (2). In contrast to biotrophic fungal pathogens, necrotrophic pathogens like *Fusarium pseudograminearum* and *F. culmorum* that cause *Fusarium* crown rot infections, benefit from plant cell death by utilising dying plant tissue to facilitate their spread throughout the plant (3).

MATERIALS AND METHODS

Seedling Germination.—Seeds of the *Fusarium* crown rot susceptible wheat cultivar Puseas and partially resistant wheat line 2–49 were sterilised in 5% NaOCl for 1 hour and were then germinated in the dark on petri dishes containing 2% water agar.

Seedling Inoculation.—Seedlings were inoculated with a single spore of *F. culmorum* or *F. pseudograminearum* on a 2% water agar block using an adapted procedure of Mergoum *et al.* (4) and harvested 10 days post-inoculation.

Microarray analysis of *F. culmorum* infection. RNA was extracted from non-inoculated and *F. culmorum* inoculated seedlings of 2–49 and Puseas and hybridised to Affymetrix® wheat gene chips. Gene transcripts in the inoculated treatments determined to be significantly induced or repressed two-fold over the non-inoculated treatments were analysed using the GeneSpring GX_7_3 program (Agilent).

Deoxynivalenol (DON) Application.—10 ul of 10 mg/ml deoxynivalenol was applied to a block of 2% water agar attached to growing seedlings of 2–49 and Puseas and was taken up by the seedling for 24 hours.

Staining for cell death was visualised in some of the seedlings by applying a second agar block containing 10 ul of 0.1% Evans blue dye below the block containing DON and allowing the stain to be taken up with the DON for 24 hours.

RNA extraction, cDNA, and real-time PCR.—RNA from *F. pseudograminearum* inoculated or DON applied seedlings was extracted using the Plant RNA Purification Reagent protocol (Invitrogen). cDNA was produced using gene specific primers in a reverse transcriptase reaction. cDNA transcripts were assayed using real-time quantitative PCR using SYBR green in the Rotor-Gene 6000 thermocycler.

RESULTS AND DISCUSSION

Table 1. Gene transcript levels expressed during infection with *F. culmorum*.

Genes	2–49	Puseas
Cathepsin B	1.58	2.09
Mlo-like protein	2.26	-1.05
Catalase	-2.19	-4.40
Manganese SOD	40.69	1
superoxide dismutase **		

Genes involved in the hypersensitive cell death response during *F. culmorum* infection (Table 1) were identified using a microarray analysis with the Affymetrix® wheat chip. Cathepsin B, a plant cysteine protease, was induced in the susceptible cultivar Puseas during *F. culmorum* infection. Catalase, an enzyme preventing hydrogen peroxide accumulation, was repressed in Puseas. A Mlo-like protein (cell death regulator) and manganese superoxide dismutase were up-regulated in the resistant wheat line 2–49. These genes are under current investigation during infection studies with *F. pseudograminearum* and DON application to determine what role they have in the response of these cultivars to infection.

Infection with *F. pseudograminearum* spores and DON has been shown to elicit hydrogen peroxide formation and plant cell death as well induce genes involved in defence responses in wheat (5). It is not known whether hypersensitive cell death or avoidance of hypersensitive cell death during infection with *Fusarium* species plays a role in the susceptibility or resistance of wheat cultivars to *Fusarium* crown infection. Further investigation of these genes during the infection process with *F. pseudograminearum* and DON is needed in order to determine if different levels influence hypersensitive cell death and the role they have in either enhancing susceptibility or resistance in wheat during *Fusarium* crown infection.

REFERENCES

- Delledonne M, Zeier J, Marocco A, Lamb C. (2001) Signal interactions between nitric oxide and reactive oxygen intermediates in the plant hypersensitive disease resistance response. *Proc of the Nat Acad of Sci* **98**, 13454–59.
- Gilroy EM, Hein I, van der Horn R, Boevink PC, Venter E, McLellan H, Kaffarnik F, Hrubikova K, Shaw J, Holeva M, Lopez EC, Borrás-Hidalgo O, Pritchard L, Loake GJ, Lacomme C, Birch PR. (2007) Involvement of cathepsin B in the plant resistance hypersensitive response. *Plant J* **52**, 1–13.
- Govrin EM, Levine A (2000) The hypersensitive response facilitates plant infection by the necrotrophic pathogen *Botrytis cinerea*. *Curr Biol* **10**, 751–57.
- Mergoum M, Hill JP, Quick J (1998). Evaluation of resistance of winter wheat to *Fusarium accuminatum* by inoculation of seedling roots with single, germinated macroconidia. *Plant Dis* **82**, 300–2.
- Desmond OJ, Manners JM, Stephens AE, Maclean DJ, Schenk PM, Gardiner DM, Munn AL, Kazan K (2008) The *Fusarium* mycotoxin deoxynivalenol elicits hydrogen peroxide production, programmed cell death, and defence responses in wheat. *Mol Plant Pathol* **9**, 435–45