



Weed Expertise to Taiwan



Water hyacinth and other aquatic weeds invade a fallow rice paddy.



Rice growing in Hualien County, eastern Taiwan.

The Taiwanese Government is calling on Bio-Protection Research Centre expertise as it develops a strategy for dealing with invasive weeds.

Professors Richard Duncan and Philip Hulme recently spent a week in Taiwan with other international experts learning about and advising on the country's National Invasive Species Inventory Project, which, as Richard explains, is aimed at identifying exactly which weed species are present in Taiwan and where and how they are distributed.

"This survey will be carried out by Taiwanese researchers over the next four years. It's a big project, so it's important that it is well planned. Our contribution is in the area of survey design... advising on the best techniques for sampling and identifying weeds in Taiwan and its neighbouring islands.

Following two days of symposium presentations, the pair spent five days travelling with Taiwanese project leaders to gain a first hand view of the island's natural and developed landscapes. Richard says the aim of the trip was to develop a clear picture of the types of landscapes to be surveyed, as not all sampling techniques are appropriate for all environments.

"Topographically Taiwan resembles New Zealand. Both are island nations with intensively developed lowlands and rugged mountain ranges covered with native forest and alpine vegetation. Obviously weed sampling will be easier in the lower, developed areas than in remote mountain regions, so it's important to design

the survey in such a way that ease of access to an area doesn't skew the results."

Now back in New Zealand, Richard and Phil say their trip was interesting and informative. They were surprised that despite recent rapid urban and industrial development, exploitation of natural resources and high dependence on international trade, Taiwan has far fewer invasive weeds species than New Zealand.

"During our time in Taiwan we didn't see any really serious weed invasions", says Richard, "although I believe there are concerns about aquatic weeds such as water hyacinth with the potential for damaging natural and commercial waterways, and woody weeds which could move into forest margins. The Taiwanese Government is being very pro-active in its approach."

Prof Duncan's expertise is in understanding the processes involved in weed species introduction, establishment and spread while Prof Hulme specialises in the ecology of invasions and their effects on natural and managed ecosystems. Both are based at Lincoln University.

For more information:

Prof Richard Duncan or Prof Philip Hulme
email: richard.duncan@lincoln.ac.nz or
philip.hulme@lincoln.ac.nz
phone: (03) 325 3696

From the Director



Prof Alison Stewart

Technology is constantly moving forward and new appointments and collaborations within the Centre confirm that bioprotection research is moving with it. Once the domain of entomologists, pathologists and weed

scientists, the bioprotection discipline base is expanding to include a new wave of biologists: scientists whose first degrees were taken in areas like mathematics and computer science. As technology progresses, these modellers and bioinformatics specialists provide new ideas on experimental design and up to the minute data processing skills to maximise the knowledge gained from research programmes.

The movement towards the increased use of these skills in bioprotection is also evident in the research being undertaken by our new students and postdocs. Twelve new TEC funded projects began in February, providing us with the opportunity to take on six postdoctoral researchers and 11 PhD students. FRST funding is supporting another three PhD students, while others receive industry funding. We have also received AgMARDT support for two postdoctoral researchers. These young scientists, working in areas ranging from ecological informatics to ecosystem enhancement, will help to provide a strong base for bioprotection research into the future.

Several of the new TEC projects fall into the category of invasive species research. This reflects increased awareness by government and stakeholder groups of the importance of identifying and intercepting new invasive species, and managing existing ones. Centre staff are involved in national and international collaborations and consultancies in biosecurity and invasive species research, and this increased funding can be read as positive recognition of our research strengths in an area crucial to protecting New Zealand's productive industries and natural environments.

Recognition of Centre staff and research has not been confined to new projects. It is very pleasing to see Theme Leader Stephen Goldson's appointment to the Council of the Royal Society of New Zealand and Steve Wratten's PGG Wrightson Significant Achievement Award.

Berkeley links aid research

A month at UC Berkeley has left PhD student Shengjing Shi 1600 times clearer about the bacteria present in the soil microbial communities she is working on.

Shengjing received training on PhyloChip testing at Lawrence Berkeley National Laboratory and as a result, was able to identify 1600 bacterial species in samples she took with her from the New Zealand Biotron at Lincoln University.

Having confirmed the communities present in her samples, Shengjing then treated them with organic acids and sugars to mimic the action of pine root exudates, and retested to see how the mock exudates affected the makeup of those communities.

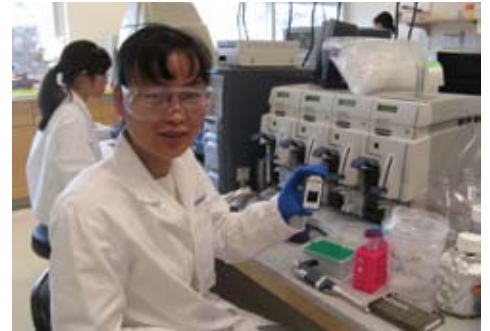
"There were definitely measurable effects, some clearer than others. If I had done this test here at Lincoln using my usual DGGE technique, I could have shown that the two samples had different communities, but not the presence or absence of individual species. That's the beauty of the Phylochip technique, it can identify up to 8000 species from one sample."

The long term aim of Shengjing's work is to clarify the link between root exudates and beneficial soil microbes and find a way of using those exudates to enhance microbial action.

While in Berkeley, Shengjing gave two talks on the New Zealand Biotron, made many useful science contacts and learned a lot about data analysis.

PhyloChip testing was developed at Berkeley. It's a DNA microarray that can quickly and accurately identify species within microbial samples from any environmental source, without culturing. It is very sensitive, but expensive and currently not available in New Zealand.

Shengjing was invited to UC Berkeley by Prof Mary Firestone who viewed her research in the Biotron during a visit to Lincoln University in 2007. She is currently in the final stages of writing up her PhD thesis.



Shengjing Shi in the Lawrence Berkeley National Laboratory. She is holding a Phylochip.

For more information:

Shengjing Shi
email: shengjing.shi@lincolnuni.ac.nz
phone: (03) 325 3696

Queen's Birthday Honour

Congratulations to Professor Alison Stewart, who was appointed a Companion of the New Zealand Order of Merit (CNZM) in recognition of her services to biology, in particular plant pathology.

Alison says the appointment came as a complete surprise and that she fully appreciates the honour.

"I've always believed in the value of science and in particular the value of bioprotection science. I'm delighted by the appointment, not just on a personal level, but because I see it as a public acknowledgement of the importance of bioprotection research and of the success of the Bio-Protection Research Centre as a whole."



Turning data into knowledge

Intelligent systems for biosecurity



Nik Kasabov

“The challenge for the 21st century is to find ways of converting cheap data into valuable knowledge.”

That’s the message from artificial intelligence researcher Prof Nik Kasabov, whose work is inspired by the human brain’s capacity to learn from data, make predictions and cope with variability.

Nik develops novel, generic techniques for processing data and is currently working in the very new field of quantum-inspired spiking neural networks (QiSNN). QiSNN can deal with huge quantities of data more quickly, consistently and reliably than traditional computer modelling techniques.

“All researchers, whatever their field, produce large quantities of data, which in itself has no value. However, if that data can be processed, using effective and efficient techniques, it will produce knowledge, and knowledge does have value.”

Nik collaborates with Dr Sue Wornor on the ‘Intelligent Systems for Biosecurity’ project, which seeks to predict which of thousands of potentially invasive pest species pose a real risk of establishing in New Zealand.

In theory it seems as easy as looking out for pest species from places with similar climates to ours. In practice, it’s not easy at all. New Zealand has hundreds of natural, developed and urban habitats across several islands with a range of climates, and potential pests can be found in an equally diverse range of habitats around the globe. This complex ecological problem is perfectly suited to QiSNN, which, as Nik explains, is able to identify which of many ecological variables may influence pest establishment.

QiSNN considered seasonal temperature, rainfall and soil moisture variables for more than 200 global sites for Mediterranean fruit fly and showed that winter temperatures, autumn rainfall and degree days were key factors influencing

establishment. This is valuable knowledge, as it provides clear direction on potential fruit fly ‘danger zones’ in New Zealand.

Prof Kasabov is the Founding Director and Chief Scientist of the Knowledge and Engineering Discovery Research Institute (KEDRI) at Auckland University of Technology. He has been working with the Bio-Protection Research Centre since it was formed in 2003.

For more information:

Prof Nikola Kasabov
email: nkasabov@aut.ac.nz
phone: (09) 921 9506

Managing the information overload

Making the most of huge quantities of data is also the focus of Massey University's Dr Murray Cox, another recent addition to the Bio-Protection Research Centre.

Murray works in the area of computational biology and in particular, processing the "tons" of data produced by Massey's new Illumina sequencer, a second generation machine that can produce up to 18 billion base pairs per run, compared with the mere 20 thousand base pairs of its predecessor.

"Sequencing genomes is getting faster and cheaper. It took years to sequence the human genome, but with this new machine it would take just a few weeks, and with the next generation machines, coming soon, it should be possible in just a few days. Research that used to cost millions of dollars is now down to just a few thousand."

"This is fantastic for scientists, but it does mean that data is coming through in unprecedented quantities. The Illumina machine doubled the demand on the Massey IT system and required a dedicated server with 16 terabytes (that's 16 x 1000 GB) of hard drive storage."

"The capacity of these machines means that you have to be very specific about experimental design or you'll be swamped with data. My job is to assist researchers with that design and also to process the data coming through. I have a background in biochemistry and genetics, but this part of the work requires serious statistics and computer science."

Murray has only been on the job for a couple of months, but already the work is rolling in. He is working with Prof Barry Scott on *Epichloë*-ryegrass interactions, Dr Rosie Bradshaw on sequencing and analyzing the *Dothistroma* genome, Prof Alison Stewart on identifying DNA variation in *Trichoderma*, and he's expecting more.

Murray's appointment is funded by Massey University, the Bio-Protection Research Centre and the Allan Wilson Centre for Molecular Ecology and Evolution.

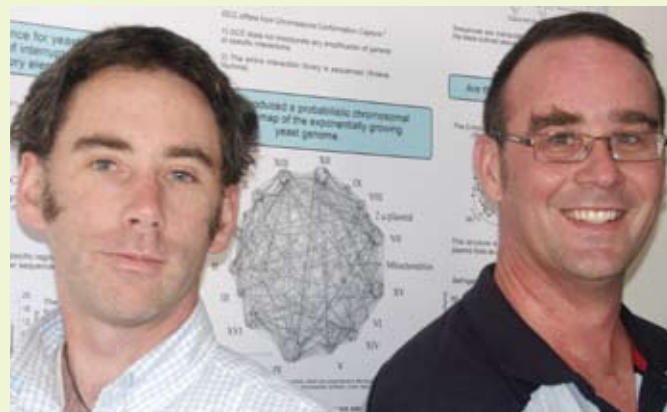


Computational biologist Murray Cox

For more information:

Dr Murray Cox
email: m.p.cox@massey.ac.nz
phone: (06) 356 9099 extn 2570

Novel DNA sequencing project wins international prize



Austen Ganley and Justin O'Sullivan (photo ex Massey News)

Coming up with a novel DNA sequencing application has provided Centre researcher Austen Ganley and his Massey University colleague Justin O'Sullivan a huge boost to their research programme.

The pair have won 20 billion bases of DNA sequence from the new SOLiD™ 3 sequencer system at the University of Otago High Throughput DNA Sequencing Unit in an international competition called "What would you do with a \$10K genome?" They will use the prize to investigate the spatial organisation of the genome.

Dr Ganley explains that while most DNA sequencing projects look at the linear order of genes on the genome, the genes also sit in a three dimensional context within the nucleus, and that he and Dr O'Sullivan are more interested in their spatial layout.

"We believe that spatial organisation is functional, rather than random, and that a gene's location affects if and when it is expressed. To test this, we're creating mutant forms of brewers' yeast by switching the position of the ribosomal DNA genes from one chromosome to another. Using the SOLiD™ 3 system we will be able to compare gene expression between the mutant and wild type strains."

The first lot of tests will be done in July, and Drs Ganley and O'Sullivan, both Senior Lecturers at Massey's Institute of Natural Sciences, see spin-offs for disease research as well as developments in scientific methodology and theory if their predictions are proved correct.

For more information:

Dr Austen Ganley
email: a.r.ganley@massey.ac.nz
phone: (09) 414 0800 extn 41512

Understanding plant diseases

“Plant pathology tends to support a myriad of projects, so I’ve got my finger in quite a few pies!”

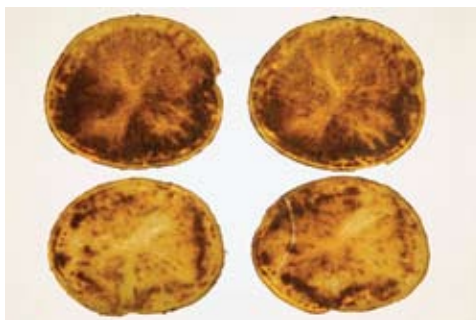
That’s something of an understatement from molecular microbiologist Dr Andy Pitman who splits his time between the Centre and Plant & Food Research, and whose work ranges from a Marsden funded project on the evolution of virulence in bacterial pathogens, to commercial diagnostic work on fungal and bacterial diseases of potatoes.

Andy works predominantly in the area of plant pathogen genetics: the molecular characteristics of plant diseases, their modes of action and plant responses to them.

Enterobacteria, a bacterial group which causes diseases in food crops throughout the world, is one of the most important pathogen groups Andy is investigating. He is leader of a Tertiary Education Commission funded project in the Systems Biology theme, which will sequence the genome of several bacteria causing black leg and soft rot of potatoes. Comparative genomics will be used to establish key virulence factors involved in these diseases. The project will also investigate plant responses to the bacteria.

At the same time, management options are being sought for *Rhizoctonia*, the fungus which causes stem canker and black scurf in potatoes. This Foundation for Research Science and Technology funded project includes new PhD student Subha Das, Plant & Food Lincoln.

The majority of Andy’s work is on potatoes, but he was also the science leader for PFRs emergency response team that assisted MAF and HorticultureNZ with the incursion of



Liberibacter, or zebra chip disease, causes unwanted stripes in potato chips.



Enterobacteria can reduce potato crop yield and storage life.

Liberibacter. This pathogen impacted seriously on export crops of tomatoes and capsicums last season and has now decimated many of the potato crops in the North Island. He works on brassicas in the Smart Seeds Programme, diagnostics for Better Border Biosecurity and the AgMARDT funded programme on *Rhizoctonia* as well.

For more information:

Dr Andy Pitman
email: andrew.pitman@lincoln.ac.nz
phone: (03) 325 2696 extn 8112

Visitors and Conferences



Prof Miguel Altieri, University of California, Berkeley and Prof Tony Shelton, Cornell University, debated the role of GMOs in biological control at the 3rd International Symposium on Biological Control of Arthropods in February, 2009. The debate was chaired by Prof Steve Wratten.



Prof Barry Scott and Dr Rosie Bradshaw, Massey University, gave invited talks at the 25th Fungal Genetics meeting at Asilomar, Pacific Grove, California. This is the most important international meeting on Fungal Genetics and is held every two years. Six people from Barry’s lab were amongst the 950 attendees.



The Bio-Protection Research Centre hosted Prof Bob Costanza at Lincoln in March. Prof Costanza, from the Gund Institute at the University of Vermont, is a renowned ecological economist with links to Prof Steve Wratten’s ecosystem services research. While at Lincoln he gave a well attended talk on “Opportunities for Real Solutions Presented by the Current Global Recession”.

The 7th World Potato Congress

More than 600 people from 39 countries converged on Christchurch in March to hear the latest on world food production in general and plant improvement, crop management, processing, marketing and food issues relating to potatoes in particular.

Industry priorities for management of soilborne diseases were highlighted. Latest research results on *Rhizoctonia* diseases, powdery scab, and common scab were presented by delegates from the United Kingdom, South Africa, Australia and New Zealand.

Centre Deputy Director Prof Richard Falloon chaired the Programme Committee and

along with Dr Andy Pitman, co-ordinated a pre-Congress workshop on Soilborne Diseases of Potato. The workshop was attended by over 150 researchers, growers, and personnel from potato processing and marketing companies.

Proceedings of the 7th World Potato Congress can be viewed at www.potatocongress.org

Media and communications inquiries:

Anna Heslop
email: anna.heslop@lincoln.ac.nz
phone: (03) 325 3696 extn. 8567
website: www.bioprotection.org.nz

ISSN 1178-9840



Bio-Protection
Bioprotection science for New Zealand

The future of bioprotection

The Bio-Protection Research Centre welcomes a new cohort of PhD students, beginning projects across the full breadth of the Centre's areas of research interest.

"These students are excellent new recruits to the bioprotection sciences", says Centre Deputy Director Prof Richard Falloon. "They come from diverse backgrounds, but have uniformly high achievements at undergraduate level. We are confident that they will all make significant contributions to bioprotection knowledge for New Zealand."

The policy objectives for the Centre are; to support excellent, world class research, that contributes to national science and innovation goals, leads to effective knowledge transfer, and develops human capability. These students will contribute to all of these objectives.

The students are working on a range of projects across several of the plant protection disciplines, contributing to biosecurity, host/symbiont interactions, plant disease control, and weed ecology. Their projects involve close interactions between the different Bio-Protection Research Centre partner institutions, with support funding from the Foundation for Research, Science & Technology and several key end-user organisations.

Gemma Cartwright

Title: Signalling in the *Epichloë festucae - Lolium perenne* symbiotic association.

Gemma completed her BSc (Hons) at Massey and a Summer Scholarship with Barry Scott has developed into a PhD project. Gemma is a 2008 Massey University Scholar.

Supervisor: Prof Barry Scott (Massey University). *Co-supervisor:* Dr Rosie Bradshaw (Massey University).



Luc Tran

Title: Population phenology of Tomato/potato psyllid (TPP) (*Bactericera cockerelli*) and the efficiency of selected natural enemies for its control.

Luc completed his BSc at Vietnam Forestry University and completed his MSc in Entomology at Colorado State University.

Supervisor: Dr Sue Worner (Lincoln University). *Associate supervisor:* Dr Roddy Hale (Lincoln University). *Co-supervisor:* Dr David Teulon (Plant & Food Research)



Damian Bienkowski

Title: Bio-control of potato black scurf.

Damian has a BSc in Biology (Plant Science Honours) from Edinburgh University. He has worked in Kenya, on the Millennium Seed Bank Project and in the Plant Metabolism group of the Environmental Science Division of a contract research organisation.

Supervisors: Prof Alison Stewart (Lincoln University) and Prof Richard Falloon (Plant & Food Research). *Associate supervisor:* Mark Braithwaite (Lincoln University). *Co-supervisor:* Dr Kirstin McLean (Lincoln University).



Lizzie Wandrag

Title: The role of mutualisms in Acacia invasions in NZ and Australia.

Lizzie has a BSc from Stirling University and an MSc in Ecology from Aberdeen. She spent a year in Tanzania coordinating biodiversity surveys and implementing small-scale community environmental projects with local Maasai, and as an ecological consultant in the UK.

Supervisors: Prof Phil Hulme, Prof Richard Duncan (Lincoln University). *External co-supervisor:* Dr Andrew Sheppard (CSIRO).



Rupert Collins

Title: Molecular identification of ornamental fishes for biosecurity.

Rupert holds a BSc in Marine and Freshwater Biology, and an MSc in Taxonomy and Biodiversity from Imperial College, London. His research interests are species level taxonomy and systematics of freshwater fishes, including many of those popular in the aquarium trade.

Supervisor: Dr Karen Armstrong (Lincoln University). *Associate supervisor:* Dr Rob Cruickshank (Lincoln University). *External co-supervisors:* Dr Suzanne Keeling, Dr Colin Johnston (MAF BNZ).



Subha Das

Title: Molecular characterisation of dsRNA viruses affecting virulence of *Rhizoctonia solani* on potatoes in New Zealand.

Subha completed his BSc in Microbiology (Honours) in 2003 and an MSc in Genetics in 2005 at the University of Calcutta, India. His research work has ranged from shrimp virology to molecular plant virology and neurogenetics.

Supervisors: Prof Richard Falloon, Dr Andy Pitman (Plant & Food Research), Prof Alison Stewart (Lincoln University).



Royal Society Appointment

Professor Stephen Goldson, Biosecurity Theme co-leader has been elected a Vice-President of the Royal Society of New Zealand (RSNZ). Prof Goldson, who has been a Fellow of the Royal Society since 2006 and is on the National Science Panel is very positive about this new position.

"The Royal Society has an important role in the representation of scientists and science issues, and currently there is real potential in investigating options for further enhancing the performance of the New Zealand science system. I look forward to contributing to such opportunity."

The RSNZ Council has six vice-presidents, each representing a different research area. Prof Goldson began his term on 1 July and will be responsible for Biological and Life Sciences, replacing Dr Brent Clothier of Plant and Food Research.

For more information:

Dr Stephen Goldson
email: stephen.goldson@agresearch.co.nz
phone: (03) 325 9911

Significant Achievement for Greening Waipara

Prof Steve Wratten has won the PGG Wrightson Seeds 2009 Significant Achievement Award in Agriculture/ Horticulture for his work on the Greening Waipara project.

The judges were impressed by the combination of research, technology development, technology transfer, marketing and community involvement in the project, which now includes around 50 Waipara properties, three biodiversity trails and formal links with Hurunui District Council.

Steve received his award at the New Zealand Institute of Agricultural and Horticultural Science Convention in June.



The Biodiversity Trail at Pegasus Bay Winery, part of the Greening Waipara project.

For more information:

Prof Steve Wratten
email: steve.wratten@lincoln.ac.nz
phone: (03) 325 3696 extn 8221