

Systems biology in full swing

This year is marking a critical turning point in the 'Healthy trees, healthy future' (HTHF) programme as we near the half-way point and start to bring the multi-disciplinary platform together. Many of you close to the programme will be aware that we have had numerous challenges progressing the fundamental enablers to facilitate a truly systems biology approach to understanding *Phytophthora* host-pathogen interactions and disease resistance. So the team has been busy understanding the pathogen diversity, developing standard procedures across hosts, aligning supporting research technologies, establishing the data resources and establishing research agreements to screen for resistance in a wider range of kauri.

It is a real pleasure to welcome Emeritus Professor Alison Stewart as the lead to the Programme Overview Committee. Alison's wealth of experience in plant pathology and progressive technologies will provide a real boost to the implementation of the research across the programme.

Professor Travis Glare has also been welcomed to the overview committee as we develop stronger linkages with the Bioprotection Research Core programme, and *Phytophthora* projects within the BPRC that are aligned to HTHF objectives.

Nari

Anchoring our relationship with Māori

Kauri and the wider kauri forests are of considerable environmental, cultural, spiritual and economic value to New Zealanders, particularly Māori. Protecting our iconic kauri from the devastating kauri dieback disease is a key element of Scion's 'Healthy trees, healthy future' (HTHF) research programme.

From its inception, this programme has recognised the need to work with tangata whenua to achieve the best outcomes for kauri and Māori communities within kauri lands. Through ongoing dialogue, our scientists have sought to develop a deeper understanding of Māori values and contexts, and to establish strong relationships with iwi to ensure we achieve the right balance between science and community engagement.

In 2010, the Kauri Dieback Programme Tangata Whenua Roopu was established as a conduit between tangata whenua and the Kauri Dieback Programme, one of our collaborators on the HTHF programme.

In July of last year, the Roopu met with our scientists here at Scion to gain a deeper understanding of the work being undertaken within the HTHF programme and to present our research team with Te Punga, a symbolic waka anchor.

The waka anchor is beautifully handcrafted from a stone originating from a stream in the Firth of Thames. It represents the anchoring of the relationship between Scion and the Kauri Dieback Tangata Whenua Roopu in striving for a higher level of knowledge in addressing kauri dieback. The muka taura (rope) that is tied to the anchor, has been handwoven by members of the Roopu present at the hui.

"This was a wonderful opportunity to meet with, and understand the values of the



Tangata Whenua Roopu, and for them to see our connection to plants and to the land," says Programme Leader Dr Nari Williams. "It was a valuable exchange of science and mātauranga.

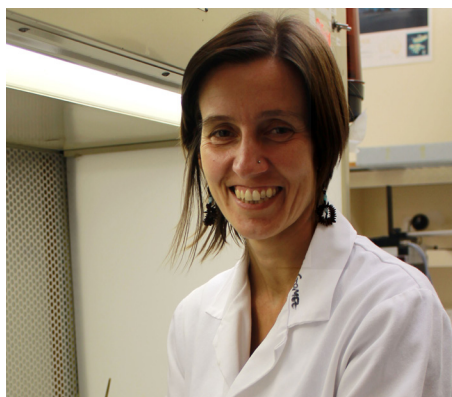
"The HTHF is an enabling programme in more ways than just science. Some of the templates and technologies we are developing as a result of this programme are actually 'enabling' a technology of trust and a linkage between mainstream science with a mātauranga vision for the long term, that sets a foundation for future engagement.

"We are finding new ways of working together, and while the road ahead may still be a bit rocky in places, both parties show a similar vision that will enable the relationship to endure beyond the funding cycles."

Paralleling the forging of this new relationship, has been the development of protocols for screening kauri material to the point where screening can now be up-scaled.

As Nari explains, "During the negotiation phase, our focus was on using robust science and working with a defined set of kauri genotypes to establish screening protocols. This is now completed and we are at the point of involving the wider iwi to screen materials within their rohe over the remaining four years of the programme."

Impacts of red needle cast on tree physiology



Mireia Gomez is investigating the effects of *Phytophthora* pathogens on host physiology.

Red needle cast (RNC) is a recently described foliar disease in *Pinus radiata* plantations in New Zealand, and *Pseudotsuga menziesii* plantations in both New Zealand and Oregon. Two *Phytophthora* species are involved in the development of RNC symptoms, *Phytophthora pluvialis* and *Phytophthora kernoviae*; the former being the main causal agent.

To date, little is known about how each of these pathogens alters the host physiology, and there is no previous research analysing the impact of foliar *Phytophthora* diseases on tree physiology. Therefore, doctoral student Mireia Gomez (pictured above) has used other pathosystems that involve fungal foliar infection, to guide her development of a theoretical framework and hypotheses to study the impacts of RNC on the physiology and growth of these economically important tree species, in both New Zealand and Oregon. These hypotheses are:

1. At the needle level, foliar infection will reduce the net CO₂ assimilation rate. As the *Phytophthora* develops, the needle will become a carbon sink instead of a carbon source, leading to its premature casting.
2. The defoliation will affect the total CO₂ assimilation rate at the canopy level, even though remaining needles are presumed to up-regulate their photosynthetic activity to compensate for the reduced leaf area. However, when defoliation is severe, the compensatory photosynthesis will not be able to maintain the same level of CO₂ assimilation at the canopy level.
3. The carbon allocation priorities within the tree will be altered. Non-structural carbohydrates will be either maintained or increased in needles and shoots in order to face refoliation, at the expense

of other carbon pools and tree growth, as there is evidence of growth reductions in infected trees.

A series of experiments will be performed to test these hypotheses under controlled conditions and in the field. Firstly, shoots of radiata pine and Douglas-fir seedlings will be inoculated with the pathogen in a greenhouse experiment. The photosynthetic parameters will be measured to assess the impact of the pathogen on needle physiology.

Secondly, both artificial and RNC-induced defoliation will be performed in seedlings in the greenhouse to evaluate the response of the remaining needles to defoliation events. Photosynthetic parameters, non-structural carbohydrates concentration across tissues and growth will be analysed.

Finally, the effects observed under controlled conditions will be scaled up in adult trees in the field, using a tree-ring stable isotopes approach.

The results will provide valuable information about the impact of the disease in the host, which will be used to establish a successful disease control strategy, as well as a better understanding of carbon dynamics, growth and survival in trees.

Phytophthora Hyphal Network Workshop connecting *Phytophthora* research across New Zealand

10.00am - 4.15pm, Monday 4 April 2016
Scion, 49 Sala Street, Rotorua.

A workshop to establish a network of researchers and land managers to foster *Phytophthora* research by optimising capacity, building research linkages, and sharing knowledge and experience. The morning session is an opportunity for researchers and stakeholders to give a brief 7 minute presentation on your research or active *Phytophthora* management programmes. In the afternoon there will be a facilitated workshop to map interests, capacity, linkages and opportunities.

To participate, please register at:
phytophthora-hyphal-network-workshop.lilregie.com

and forward your presentation title to:
preeti.panda@scionresearch.com

New General Manager for Forest Science, Alison Stewart

Emeritus Professor Alison Stewart joined Scion as General Manager Forest Science in February.

For the past three years Alison has been Senior Vice President R&D and Chief Technical Officer at Marrone Bio Innovations in California where she was involved in the development and commercialisation of bioprotection technologies for the agriculture, horticulture and nursery sectors. Prior to this, Alison was the founding director of the Bio-Protection Research Centre at Lincoln University (2003-11) and held various other roles at the University including Professor of Plant Pathology.



Alison was Deputy Chair of Plant and Food Research (2011-13), a Director of the Waite Research Institute (Adelaide), and until recently an advisory member of the Californian Institute of Food and Agricultural Research at the University of California (Davis). She is currently on the advisory board of Better Border Biosecurity (B3), and is science advisor to the PGG Wrightson-led Primary Growth Project on biological seed additives.

"I came back to New Zealand because I wanted to apply my learnings from a commercial bio-tech company to add value to the research and commercialisation space," says Alison. "I see plenty of opportunities at Scion to do that."

View more: www.scionresearch.com/alison-stewart

To learn more about the HTHF programme

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Visit our website and subscribe to our quarterly newsletter
www.healthytrees.co.nz

We would like to acknowledge the support of MBIE, the Forest Growers Levy Trust and the Kauri Dieback Programme in the funding of this programme.



Landcare Research
Manaaki Whenua

