Scion
# connections

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# Containing the spread of hitchhiking pests

The past 50 or so years has seen a dramatic change in the volume, and mode, of international trade. Not only has the volume escalated substantially, but around 90% of it is carried by sea, mostly in containers.

This is clearly illustrated by the myriad of sentry-like gantry cranes that punctuate the skyline over most major trading ports. The regimented blocks of stacked sea containers that they service amount to a staggering worldwide total port throughput per year of some 300 million containers.

The downside to this unprecedented level of global trade is the transport of unwanted contaminants and 'hitchhiker' pests that are inadvertently transported on, or in, the containers, irrespective of the cargo. Thousands of exotic species have become established in new environments – about 1700 known insect and 2400 plant species in New Zealand alone. Not all are damaging, but some have the potential to cause enormous environmental and economic impacts. This increase in biological invasions has been clearly linked to the growth in international trade.

Principal Scientist Dr Eckehard (Ecki) Brockerhoff says that inspection records from the United States, Australia, China and New Zealand indicate that thousands of organisms from a wide range of taxa are being moved unintentionally with sea containers.

He says, "Inspection records of 116,701 empty sea containers arriving in New Zealand between 2010 and 2015 showed that around 10% of them were contaminated on the outside, and 5% on the inside. This level was even higher in other countries."

Some of the better-known hitchhikers were gypsy moth, giant African snail, Argentine ant and brown marmorated stink bug - pests that seriously threaten forests, agriculture and urban environments, and cause substantial economic and environmental damage in many countries. Soil residues were also found, and these often contained seeds of invasive plants, nematodes and plant pathogens.

In 2006, the Ministry for Primary Industries implemented a hygiene system

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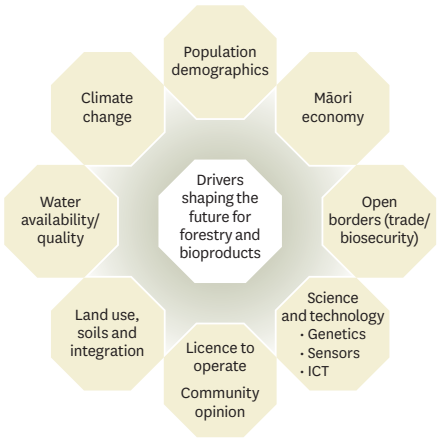
# Biosecurity a top priority for the forest industry and Scion

Biosecurity is the forest owners' top priority. Keeping trees green and healthy, and the products from these able to be sold in export markets, dominates all other considerations. Trees are forest owners' primary revenue generator and a liquid asset - if they are afflicted by pests and diseases or are restricted in their access to market, their value is seriously diminished.

Scion has built up one of the world's leading forest biosecurity teams over many years. Ably led by Science Leader Lindsay Bulman, the Forest Protection Team works very closely with industry, farm foresters and the Ministry for Primary Industries (MPI) to ensure the key issues are addressed in an efficient and collaborative manner. Our capability is enhanced by working closely with New Zealand colleagues via Better Border Biosecurity (B3)[1] and the New Zealand Biological Heritage National Science Challenge[2].

Scion's substantial worldwide network of biosecurity researchers is also extremely valuable in supporting our New Zealand efforts, and conversely, Scion is often requested to assist other countries with their forest biosecurity problems. This open and dynamic flow of ideas and methods, and exchanges of science and technical staff has built up a strong global forest biosecurity community that we can call on at any time to help the New Zealand forest industry meet biosecurity and market access challenges.

The mega trends shaping the future of the New Zealand forest industry – distilled in the diagram below – will all impact the biosecurity of New Zealand forests and our ability to undertake export trade.




Climate change through different weather patterns – drier, wetter, windier and warmer depending on the district – is shifting the bounds and movement patterns of pests, diseases and weeds. Pests are appearing where they previously did not, and *Pinus radiata* is more prone to a biosecurity challenge when suffering from water stress than under normal circumstances. Our biosecurity science has to "front foot" the multiple challenges posed by climate change through tree breeding, developing alternative species and improving surveillance and earlier detection.

The forecast increase in tourists to four million per year by 2020, one million more than present levels, combined with more New Zealanders moving to and from countries, elevates the likelihood of an unwanted organism being introduced into New Zealand. As well, our large coastline is relatively unprotected from small boats from other jurisdictions landing without being subjected to custom checks.

Biosecurity threats are not confined to exotic plantation forests; they also pose threats to indigenous species and this is of great concern to iwi. For example, myrtle rust being blown across the Tasman and infecting the *Myrtaceae* species (which includes mānuka, pohutukawa and rata) may have a serious impact on our burgeoning honey industry and iconic flowering natives.

With this context in mind, MPI's consultation on Biosecurity 2025 is very timely. Scion fully supports MPI's aspirations ('A biosecurity team of 4.7 million') to make biosecurity the responsibility of all New Zealanders and to ensure we maintain a strong, coordinated science and innovation capability that can address today's issues as well as those likely to arise in the future. The Boy Scout motto "be prepared" applies.

You can read about Scion's work on biosecurity on our website and the direction of our science programme in our Statement of Corporate Intent[3]. As well I would encourage you to look at the forest growers' biosecurity research priorities[4].

As always I welcome your comments on this topic or any of the other matters raised in this edition of *Scion Connections*.

Dr Warren Parker,
*Chief Executive*

**Want to know more?** Contact Dr Warren Parker at *warren.parker@scionresearch.com*

[1] See http://b3nz.org
[2] See http://www.biologicalheritage.nz
[3] http://www.scionresearch.com/sci
[4] In particular, HTHF (*Phytophthora*) and NDS (Needle Disease Strategy) at http://research.nzfoa.org.nz/documents/5476

# Are small forest blocks viable?

Most small forests were planted in the 1990s, and now that they are coming to maturity they have the potential to supply most of the large increase in wood availability over the next decade.

However, some small forests have been poorly managed and, when this is combined with a poor location, it can be uneconomic to harvest the trees. Financial losses and factors such as road damage and concerns about road safety due to logging trucks has contributed to an anti-forestry sentiment in some districts.

This needs to be rectified because small forest growers have a strong influence on the public perception of forestry as an investment and thus on whether reforestation and new forest planting occurs.

Enlarging New Zealand's planted forest area to secure long-term log supply, support regional economies and help New Zealand achieve its goals for climate change and fresh water quality is therefore dependent to a good degree on how small forest owners fare over the next decade.

A report on future wood availability compiled recently for the Ministry for Primary Industries has shed light on the number of small forest blocks (in this study those up to 40 hectares) expected to be harvested, and the probability these blocks will be replanted.

The study indicated that more than 91% of these small forests will be harvested.

As expected, the terrain of the forest block, access to roading and distance to a port or mill had a strong influence on forest profitability.

The report's authors, Barbara Hock, Duncan Harrison and Richard Yao, used large national datasets that map existing forests, and their location, size and age, to determine the forests that are most likely going to be harvested and estimate the probably that they will be replanted. By applying these data to Scion's Forest Investment Finder (FIF) economic model, the research team was able to establish the costs associated with planting, silviculture, roading, felling and terrain, transport and log yields, and a log price for individual small forest blocks.

Small forests do not have the economies of scale available to them that large forests have so it was encouraging that the modelling indicated only about 6-9% of small forest blocks would be uneconomic to harvest. These blocks are spread around the country and, mostly due to remoteness, may not be harvested at all. Pruning regime had little effect on intention to harvest. A 5% or 10% increase in log price increased the percentage of forests that becomes economic to harvest by 2.1% and 3.4% respectively.

Working with nearby forest owners to coordinate harvesting and share some costs can help too.

The effect of improved carbon prices is complex and forest specific. While a higher carbon price can improve cashflow for an ETS-qualifying forest during the growing phase, the carbon liability associated with harvesting needs to be repaid. In some circumstances, a high carbon price could make retaining the forest more economical than harvesting it.

So what does the future hold for small forest blocks?

Based on trends over the past 20 years, and taking into consideration data such as location, slope, catchment, proximity to other land uses and industry, and people density, lead author Barbara Hock says there are no real surprises.

"The small blocks of forest least likely to be replanted are those near larger urban areas, situated on lower slopes and where there is strong competition with other land uses such as in the Waikato and Canterbury".

**For further information**
on Scion's work with small forest growers contact Professor Alison Stewart at *alison.stewart@scionresearch.com*

*Family lines of kauri seedlings germinated at Scion's research nursery in preparation for screening with* Phytophthora agathidicida.

# Fighting back with science

Kauri (*Agathis australis*) are the slow growing giants of our northern forests revered by all New Zealanders, particularly Māori.

In recent years, these iconic trees have been struck down by kauri dieback, a prolific wasting disease caused by the soil-borne fungus-like organism *Phytophthora agathidicida*, which grows within its host's roots and slowly chokes it to death. To date, there are no effective methods of managing kauri dieback and given the slow regeneration time of kauri, this insidious pathogen is causing major concern.

*P. agathidicida* is a newly described species of *Phytophthora*, and at this stage it is unclear whether our trees have any inherent resistance to the pathogen. Finding this out is a key focus of Scion's 'Healthy trees, healthy future' (HTHF) research programme, which aims to identify markers and establish screening methods to assess the breadth of disease resistance. In doing so, we hope to understand more about the mechanisms of disease resistance.

## The science behind the scenes

Key to our research, says Research Leader Dr Nari Williams, is the question of what resistance will look like, and whether it will last for the lifespan of the tree. Is it genetic or biochemical, or a physiological response in the tree that slows the rate of growth of the pathogen? Does the host produce inhibitors that delay or interrupt the pathogen's reproduction and limit its spread?

**Our chemists are focusing on understanding the chemical mechanisms of resistance by analysing the biochemical reaction that occurs at, and following, the time of infection.**

To date, laboratory trials show *P. agathidicida* to be an extremely efficient pathogen that can kill non-resistant two year old kauri seedlings a mere 20 days after inoculation. Scion's HTHF pathologists have developed a technology that enables them to view the pathogen growing within the host's roots; it reproduces rapidly and forms specialised structures that help it to survive even when the host is dying.

Our chemists are focusing on understanding the chemical mechanisms of resistance by analysing the biochemical reaction that occurs at, and following, the time of infection. These data will provide us with a characteristic 'chemical fingerprint' of a healthy plant, and of one that is being challenged by a pathogen. Further analyses will then be able to identify the actual chemical changes that occur at the time of infection. This could prove to be a unique diagnostic test for the disease prior to a tree showing signs of disease and give indications of the mechanisms involved in pathogen defence. Otherwise it can be years before the tree shows any outward signs of the disease.

## Screening for success

Preventing the spread of *P. agathidicida* and finding resistant strains of kauri from

which to breed are a major focus for Scion. The first phase of the HTHF programme involved the research team using robust science to establish screening protocols for a range of *Phytophthora* species. This is now complete and the team is working with regional mana whenua groups to start screening kauri sourced from within their rohe. This year, the team has successfully raised 3000 kauri seedlings in a specially contained area of Scion's research nursery. The seed was collected from five mana whenua in Northland where there is a high rate of kauri dieback.

"We'll do another seed collection this year to extend the collection and geographic range of seed, or provenance. This will also include further mana whenua groups in the screening programme," says Nari.

"The key to this whakapapa line work is how resistance varies between siblings. For example, the seed we collect from a single mother tree has been pollinated by a pollen donor somewhere upwind. If one seedling proves to be resistant, there is either a resistant pollen donor in the area, or the mother is resistant. This is where we need to understand the structure of resistance – is it one gene, or a group of genes, and what does the pathogen do when it infects a seedling?

"Early stages of screening have already shown different responses to *Phytophthora* infection across different kauri lines. While promising, there is still a great deal we don't know about how our various screening assays relate to disease susceptibility as trees age and across environments, or provenances."

Nari and the team have begun a screening assay in collaboration with Landcare Research that involves inoculating the current lines of seedlings with *P. agathidicida* in controlled conditions, then monitoring them for signs of infection using established genetic and biochemical screening protocols. The surviving seedlings will be inoculated in a further 6, 12 or 18 months' time.

Pending the results, surviving seedlings will be planted in areas where the disease is present in order to challenge them under natural conditions. Each seedling will be carefully monitored for disease development over time.

### Where to from there?

Once Nari and the team have identified a line of kauri that is resistant to *P. agathidicida* the future will look a lot healthier for our majestic giants of the north. The next step will be to launch a dedicated genetic breeding programme. That, says Nari, is a few years away yet.

**For further information**
Contact Dr Nari Williams at
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www.healthytrees.co.nz

## Help stop the spread of *Phytophthora* in our forests

Plan and prepare:

- Obey all signage in natural areas and stay out of areas with kauri dieback
- Check for suitable walking or cycle tracks, and keep to the tracks
- Avoid walking or cycling in forests if soil is wet or muddy
- Ensure footwear, bike and all other equipment are free of soil or mud before entering the forest
- Make sure your vehicle is clean before entering the forest area
- Park your vehicle in designated car park
- Dispose of waste properly
- When you leave the forest, avoid transporting soil and mud on your shoes, bike or camping equipment by using the designated wash stations, or your own hygiene kit. Scrape off any soil, wash boots or bike tyres with fresh water, and spray with diluted methylated spirits to sterilise the soles of shoes.

# Containing the spread of hitchhiking pests

*(Continued from page 1)*

for sea containers coming into New Zealand from several Pacific Island countries that, according to MPI, has since reduced the contamination rate of containers from those countries by 90%. This involves inspection, cleaning, verification, training and prevention of contamination. Prior to this, every second empty container arriving in New Zealand from these origins were contaminated.

Ecki has been working with MPI and the Better Border Biosecurity Collaboration to advance the development of an International Standard for Phytosanitary Measures (ISPM) to reduce the incidence of hitchhiking pests on sea containers worldwide. Ecki was invited to present a paper on this work to the Commission on Phytosanitary Measures (CPM), the governing body of the International Plant Protection Convention (IPPC), when it met in Rome in May. The IPPC is responsible for setting phytosanitary standards for international trade in plants and plant products.

"Our research shows there are considerable risks associated with sea containers moving pests and other contaminants around the world, and that an international phytosanitary standard for sea containers is likely to reduce pest arrivals and establishments substantially," says Ecki. "It will also provide economic net benefits as a result of avoided damages caused by invasive species and other contaminants being transported with sea containers.

"This would be a huge benefit to border biosecurity, as well as reducing compliance costs for shipping companies, exporters and importers both in New Zealand and worldwide."

While the CPM delegates made the decision to take more time to develop an ISPM, they agreed the risks warranted action. In the meantime the effectiveness of voluntary measures will be explored, and the ISPM will be revisited in five years.

Director for Plants, Food & Environment at MPI, Peter Thomson says, "While the risk from sea container contamination is obvious to New Zealand, many countries either don't understand the risk, or believe it's just too hard to manage. Having Dr Brockerhoff present his findings to the 182 member countries of the IPPC was instrumental in gaining sufficient support to continue the work to better manage this risk at an international level."

**For further information**
Contact Dr Ecki Brockerhoff at
*eckehard.brockerhoff@scionresearch.com*

*Technician Ben McDonald collecting bio-oil from Scion's fast pyrolysis plant.*

# Locally produced liquid biofuels – the way to go!

Scion has been involved in bioenergy and biofuels research for many years. With most of the country's electricity derived from natural, renewable resources such as water, geothermal and wind, the focus of this work currently centres on liquid transport biofuels.

New Zealand's transport sector is 99% dependent on fossil fuels, and responsible for 17% of the country's carbon dioxide emissions. Most of the oil used to produce these transport fuels is imported.

"New Zealand currently imports about eight billion litres of oil a year, it's our biggest import," says Research Leader Dr Ian Suckling. "If we can replace some of this imported oil with locally produced 'climate smart' biofuels, it would significantly improve our balance of trade, and reduce our reliance on fossil fuels. It would also generate numerous business and employment opportunities for the regions.

"And the benefits for our environment would be immense - replacing fossil fuels with clean hydrocarbon biofuels would help lower greenhouse gas emissions."

This year Ian and his team of engineers, physicists and chemists have started using a newly acquired fast pyrolysis plant to convert wood into bio-oils. These oils can then be further refined into transport fuels or bio-chemicals.

**"We are focusing on developing pyrolysis to convert woody biomass directly to bio-oils. These oils can then be upgraded to drop-in fuels that can be blended directly with fossil fuels."**

The fast pyrolysis plant was designed and built by the University of Twente in the Netherlands, recognised leaders in pyrolysis research and development. It's capable of converting 1 kg of wood each hour into about 750 mL of raw pyrolysis oil. The pyrolysis reactor vaporises small particles of wood by rapidly heating them to approximately 500˚C in the absence of oxygen. The vapours are then quenched, producing the oil. The whole reaction and quenching takes place in seconds.

"We are focusing on developing pyrolysis to convert woody biomass directly to bio-oils," says Ian. "These oils can then be upgraded to drop-in fuels that can be blended directly with fossil fuels.

"There is a lot of variation in wood and how it could be pre-treated before being put into fast pyrolysis. Each treatment might result in different qualities of bio-oil, which in turn, may affect its suitability for conversion into fuels.

"We analyse the characteristics of the bio-oils we produce, and we're currently using the pyrolysis plant to trial various temperature settings, feedstocks and pre-treatments to identify the best combination for specific fuels."

Ian says that while the pyrolysis of wood to oil is already at a commercial stage internationally for industrial energy and heating use, Scion's research focuses on converting it to a transport fuel and generating New Zealand specific solutions.

"It's technically challenging breaking down the cellulose, hemicelluloses and lignin components of woody biomass into a final fuel," he says. "Conversion technologies tend to be complex and consequently have high capital and operational costs. The challenge is finding a technology to produce lignocellulosic biofuels cheaply and on a large scale; the next hurdle will be the availability of feedstock."

The COP21 Paris Climate Agreement and Z Energy's new biobased plant has stimulated increased interest in biofuels and their long-term role in the New Zealand economy. Ian sees the growing biofuel market as a huge business opportunity for New Zealand forestry. Of all possible biofuel sources in New Zealand, only our plantation forests are big enough to produce biomass on a scale to compete with the country's thirst for 8 billion litres of liquid fuels a year.

Our research has already shown that approximately doubling our plantation forest area by planting a further 1.8 million hectares of forests would meet 60% of New Zealand's liquid fuel requirements by 2035, as well as providing other benefits such as sequestering carbon, reducing erosion, improving water quality and reducing greenhouse gas emissions.

Locally produced liquid biofuels made from a renewable source, and that benefit the environment? Way to go!

**For further information**
Contact Dr Ian Suckling at
*ian.suckling@scionresearch.com*

# Woodforce nets KiwiNet award!

We are proud to announce that Scion and our licensing partner Sonae Indústria (now Sonae-Arauco) won the MinterEllisonRuddWatts Research & Business Partnership Award for our partnership to commercialise a wood reinforced plastic product that can be used in cars, appliances and a range of consumer products. The award was one of five presented annually as part of the KiwiNet Research Commercialisation Awards.

The award celebrates our long-term working relationship with Sonae Indústria to successfully establish a commercial value chain for wood fibre reinforced plastics. Scion's patented process forms wood fibre into 'dice', known as Woodforce, which is sold by Sonae Indústria to plastics processors. The dice can be made in existing MDF plants and easily added to a range of plastics.

Scion has been working closely with Sonae Indústria for eight years to refine Woodforce to the point where it is starting to make inroads into the market. End products that are lighter weight, thermally stable and sustainable are now being trialed and approved by major automotive manufacturers. A wide exposure to companies along the full length of the Woodforce value chain has also led to relationships being developed with other manufacturing industries to develop new products.

Scion's Business Development Manager Jeremy Warnes sees the commercial potential for Woodforce as being in the $100s of millions in business generated on a global scale.

Scion developed and patented the technology with funding from New Zealand's former Foundation of Research, Science and Technology (now the Ministry of Business, Innovation and Employment).

**For further information**
Contact Jeremy Warnes at
*jeremy.warnes@scionresearch.com*
http://bit.ly/2c4SQKo

# Make wood not love

Plant biotechnologist Agnieszka Boron entered a video competition for early career researchers little realising her video would come third.

In her video 'Make Wood Not Love', Aga talks about her research into conifer sterility and explains how she and the rest of Scion's plant biotransformation team intend to tackle the problem in "180 Seconds of Science".

"Short term control methods like spraying are not solving the wilding conifer issue," says Aga. "Wildings threaten over 1.8 million hectares of fragile ecosystems throughout New Zealand, and sterile conifers will be a long-term solution to the problem."

Aga is seeking to identify and regulate the genes that control fertility in conifers, enabling forest owners to grow trees without the worry of having to control wildings. This will ensure that forestry can live in harmony with New Zealand's unique native ecosystems.

"It's great to have this chance to share my research with a bigger audience," says Aga.

The competition was organised by the Royal Society of New Zealand partnered with MBIE and the Australian Academy of Science, to provide an opportunity for early career researchers in both countries to share their passion for science.

Aga entered in the "Science across the Ditch" category and came third in the People's Choice award. You can watch Aga's video at: http://bit.ly/2aT8K4O

**For further information**
Contact Agnieszka Boron at
*agnieszka.boron@scionresearch.com*

*Te Runanga o Ngāti Whare Chairman Bronco Carson with Treaty of Waitangi Negotiations Minister Chris Finlayson at the nursery opening.*

# Minginui nursery

Scion's innovative science has opened the door to what could become a lucrative indigenous forestry industry for New Zealand. Our scientists have discovered how to propagate native trees from cuttings, which enables them to grow faster and in larger amounts, and overcomes the difficulty of sourcing viable seed and unreliable germination of that seed.

The novel technology will be used by Ngāti Whare in their new state-of-the-art, million dollar nursery opened recently at Minginui, near Rotorua, on the edge of the Whirinaki Forest.
A joint venture between Scion and Ngāti Whare will enable the mass production of four indigenous podocarps – rimu, kahikatea, tōtara and miro – on a large commercial scale with assurance as to their provenance. The partnership aims to further develop the propagation approach and licence it to other indigenous nurseries across New Zealand over the next few years. This will lead to more trees being propagated with known progeny becoming available to other parties that is both reliable and affordable.

General Manager Research and Investments, Dr Russell Burton, says Ngāti Whare are showing real leadership in their approach. "We are honoured and proud to be Ngāti Whare's partner in our shared vision to restore New Zealand's indigenous forests."

Russell says the approach will require a new model for forestry where conservation and commercial activities work together. "We see native trees as complementing radiata pine with each species providing timbers with highly valued properties in quite different markets."

**For further information**
Contact Dr Russell Burton at
*russell.burton@scionresearch.com*

*Roger Schwarzenbach*

## New business development leader

Scion welcomed Roger Schwarzenbach to the team in August as our new General Manager Business Development and Commercialisation.

Roger joined us from Glanbia Ingredients Ireland, where he was the Technical Director and a member of the executive leadership team. In that role he was responsible for all research and development, technology and business development, and commercialisation from cow to customer. This included oversight of strategic intellectual property management, patents and trade secrets, and the development and execution of all of the company's intellectual property. Roger also managed external research and development relationships and was on the Board of Directors of Moorepark Technology Ltd and Food for Health Ireland.

Prior to working in Ireland, Roger was Global R&D Manager Powders, Beverages and Nutrition for Fonterra Research and Development Centre (FRDC) in Palmerston North and member of the FRDC Leadership team.

Roger is keen to apply and adapt the knowledge he has learned in the dairy sector to the science and technology here at Scion.

## Domestication of radiata pine

Emeritus Scientist Rowland Burdon has been collaborating for a number of years on a book covering the history and technical issues of domesticating radiata pine. The draft copy is now available at the website below as open-access, in pdf format for printing. Accompanying the draft material is a covering message expanding on this announcement and calling for feedback on the material.

*Domestication of Radiata Pine* is co-authored by Bill Libby, Professor Emeritus, Forestry and Genetics at University of California, and Alan Brown, formerly Chief, CSIRO Division of Forestry in Canberra.

www.kriss.net/radiatapinedomestication

# The Soft Pines Bulletin

Publication of The Soft Pines bulletin by Scion marks the completion of a 19-part series on the recognition, role and seed source of introduced forest trees in New Zealand. The first bulletin in the series was published back in 1986 with a further 17 produced over the following 14 years.

The bulletins are aimed at foresters, farm foresters, nurserymen and students. The Soft Pines bulletin provides information about *Pinus strobus, P. monticola, P. lambertiana, P. ayacahuite, P. wallichiana* and related species.

Miller, E. (2016). *Introduced forest trees in New Zealand: Recognition, role, and seed source, part 19. The soft pines - Pinus strobus, P. monticola, P. lambertiana, P. ayacahuite, P. wallichiana and related species* (FRI Bulletin No.124, part 19).

An electronic copy can be obtained by emailing: publications@scionresearch.com

# Upcoming events

**TAP 2016 Te Ara Pūtaiao.** 3-4 October, Novotel Hotel, Rotorua

This two-day symposium provides a forum for Māori and Crown Research Institutes to share knowledge and identify opportunities to support Māori growth through science collaborations. The symposium includes presentations by keynote speakers and scientists, research case studies and workshops designed to strengthen collaborative efforts to realise the potential of Māori land and water resources. Early bird registrations are now open. http://scienceevents.co.nz/tap

**7th ABRN Science Symposium: Next Generation Liquid Biofuels and Co-Products.** 10 November, Novotel Hotel, Rotorua

The Advanced Biofuels Research Network (ABRN) is combining with the Bioenergy Association to host this science symposium. The symposium is being held in conjunction with an IEA Bioenergy workshop, bringing a number of international bioenergy experts to Rotorua. Some of these researchers will be speaking at our symposium on their latest research activities and provide updates on liquid biofuel markets in their respective countries.

The event will cover all liquid transport biofuels, but specifically will be of interest for users of drop-in fuels in road transport, marine and aviation sectors.

To register go to http://www.bioenergy.org.nz/event/science-symposium-international-biofuels-developments

For all enquiries, please email: *biofuels.symposium@scionresearch.com*

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