Forest Biosecurity Research Council

A Summary of Research 2008

Members of the Forest Biosecurity Research Council:

NZ Forest Owners' Association Inc., Scion, Bio-Protection, Biosecurity New Zealand, Forest Health Research Collaborative, and the Radiata Pine Breeding Company Ltd.

Members of the
Forest Biosecurity Research Council:

NEW ZEALAND FOREST OWNERS ASSOCIATION INC

BIOSECURITY NEW ZEALAND

SCION

Bio-Protection

RPBC
Radiata Pine Breeding Co Ltd

NEW ZEALAND FHRC

Acknowledging the generous support of FRST

FOUNDATION FOR RESEARCH SCIENCE & TECHNOLOGY

Contents

Foreword

David Balfour (Chairman)

Over the past year we have continued to develop science programmes that enable growers and government agencies to manage some of the high-priority biological risks posed by invasive pests and diseases. We have also demonstrated the power of this collaboration to muster the government support needed for vital research funding.

An important milestone in 2008 was securing ongoing funding from the Foundation of Research Science and Technology (FRST) for biosecurity research in New Zealand. Scion's forest biosecurity group and Lincoln University's bioprotection programme, both of whom are core research providers for the FBRC, were successful in negotiating their funding bids. The FBRC played a key role in the negotiation process by demonstrating the close connection between end-users and research providers. We were also able to demonstrate the value of research in real outcomes, by defining best practice, making recommendations, or providing knowledge to those of us who must manage the risks to our commercial forests.

The Forest Biosecurity Research Council (FBRC) performs an important role in helping to protect New Zealand's commercial forestry resources. As a partnership between forest growers, policy makers and research providers, FBRC provides strategic direction and financial support for science programmes aimed at solving a wide range of biosecurity issues.

The government funding secured in this process underpins the bulk of forest biosecurity research capability in New Zealand. Without it we would have weak foundations on which to build. The assurance of another eight years of FRST funding allows the FBRC to deliver huge benefit to forest growers by leveraging off the large science programmes already in place. In turn, the forestry sector recognises a need to increase our financial contributions towards maintaining this science capability as inflation erodes the value of funding provided by the government.

The FRST negotiation process provided an important opportunity for the FBRC to review the strategic direction of our science programmes. This resulted in increased emphasis on maintaining the health of radiata pine, a need highlighted by Chile's experience of damaging needle blight. This strategic decision also identified the need to refocus work on alternative species, targeting the highest priority issues.

Another review focused on the relationship between the FBRC and the long-standing Forest Health Research Collaborative (FHRC). From a sector point of view, there have been concerns around the cost of maintaining two bodies. Closer investigation of this issue shows that both organisations serve niche functions, with the FHRC in particular performing an effective role in technology transfer. The small cost involved in running the FHRC was deemed to be worthwhile and so both organisations will be retained, with closer coordination between the two.

An additional milestone was achieved in 2008 with the introduction of the Radiata Pine Breeding Company as a full member. This strengthened partnership will increase the potential of tree breeding programmes to contribute to biosecurity risk management in the long term.

Finally I must thank the remaining FBRC Board members who work hard to represent our sector interests. I particularly acknowledge Ian Jolly, who has recently stepped down from the position of Chair. The dedicated contribution of these people reflects not only a professional, but also a personal commitment to the protection of our valuable forests.

FBRC Research Projects

This section of the report summarises projects co-funded by the FBRC.

A brief summary of the project titles and funding contributors is given below.

The contents of this report cover the 2008 calendar year.

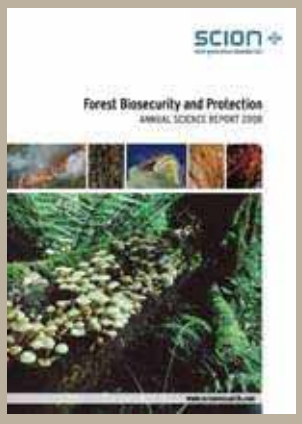
Allocation of effort spent on each of the FBRC projects ($000)

Project	FBRC	FRST	Industry	FIDA**	Total
Understanding Nectria	60	210	62	119	451
Needle-cast disease	17	134	25		176
Causes of Physiological Needle Blight	30	77			107
Induced resistance using fungal endophytes	27	250			277
Ectomycorrhiza fungi	15	54			69
Reducing pesticide sprays	10	112	145	59	326
Reducing sapstain in windthrown trees	15	38			53
Reducing methyl bromide	33		6	95	134
Microbial control of pests and diseases	50	330	115	16	511
Total	**257**	**1205**	**353**	**289**	**2104**

Government Support for Forest Biosecurity Research

The industry-funded FBRC projects described in this report are underpinned by substantial Government support from the Foundation for Research, Science and Technology (FRST). This additional funding provides benefit to the forest industry through comprehensive research programmes, the largest of which is maintained by Scion. The Scion Forest Protection programme covers the entire risk management spectrum including:

- Pre-border biosecurity
- Post-border biosecurity
- Forest weed, insect pest and disease management
- Ecosystem health and function
- Rural fire research

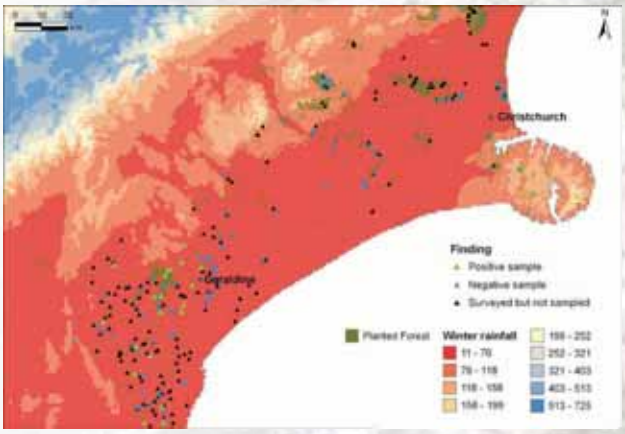


For a full summary of these programmes, see the Scion Forest Biosecurity and Protection Annual Science Report 2007/2008 – available through Scion. Contact: Rose.O'Brien@scionresearch.com for a copy.

Understanding Nectria

Nectria disease distribution on the Banks Peninsula

In February 2007, *Neonectria fuckeliana*, the causal agent of Nectria flute canker, was first recorded on the Banks Peninsula. This was 80 km northwest of the previous most northerly record of the fungus near Geraldine in south Canterbury. In April 2008, *N. fuckeliana* was found at three new locations on the Banks Peninsula. This presented a unique opportunity to study the dispersal of *N. fuckeliana.* Nectria flute canker is not abundant on the Banks Peninsula and the region is located a considerable distance from other known locations of the pathogen, meaning there are few conflicting inoculum sources. In addition, the peninsula contains a wide variety of microclimatic conditions over a relatively small area.



Average winter rainfall (June-August) in Canterbury. Surveys were undertaken from 2004 to 2008. Green points indicate positive findings of *N. fuckeliana*. Blue points denote locations where samples have been taken and *N. fuckeliana* was not recovered, and black points show survey sites where samples were not taken.

Monitoring plots were established in February 2009 to examine pathogen dispersal at both a local, site specific and regional scale. Several stands on the Banks Peninsula have been selected to examine pathogen dispersal at a local scale, each containing at least one tree on which *N. fuckeliana* has been recorded previously. Trees will be sampled every six months over several years to determine the presence of *N. fuckeliana.* To look at pathogen dispersal at a regional scale, permanent survey and monitoring sites are being selected throughout the Banks Peninsula with several complementary sites on the Canterbury Plains and near Geraldine in south Canterbury. Sites will be visited at yearly intervals to determine the presence of *N. fuckeliana* and to look for symptoms of Nectria flute canker.

Contact: Anna.Hopkins@scionresearch.com

Nectria distribution surveys

In 2008, surveys to delimit the spread of *N. fuckeliana* were undertaken throughout Canterbury, in Nelson and Marlborough, and the central North Island. Surveys in Nelson and Marlborough were done in January 2008. Fluting was seen in 33 stands and samples were taken from these. *Neonectria fuckeliana* was not isolated. The remaining 20 stands were not sampled.

From February 2008 onwards, as a result of research that showed *N. fuckeliana* may be present in asymptomatic trees, procedures were changed. Surveyors were required to take samples from all stands surveyed, whether fluting was present or not. *Neonectria fuckeliana* was isolated from one stand out of the 55 sampled in South Canterbury, and from five stands out of the 68 sampled in mid-Canterbury. The one stand in South Canterbury and four of the five stands in mid-Canterbury that were positive for *N. fuckeliana* had fluting present. One of the

positive stands in mid-Canterbury was free of fluting and this record would not have been made if procedures hadn't changed. Northwards expansion of the fungus in the South Island was not seen. In late 2008, surveys were undertaken in the central North Island, with 135 samples taken in Bay of Plenty forests and 160 taken in Taupo forests. *Neonectria fuckeliana* was not isolated.

Contact: Lindsay.Bulman@scionresearch.com

Influence of weather on Nectria flute canker development

In April 2008, a trial to determine how climatic conditions immediately before and after pruning operations influence disease development was established in Waipori Forest inland from Mosgiel. The objective is to optimise management strategies that are already reducing the effects of the disease. Trees are being pruned every two weeks for one year. Over that period rainfall, temperature, and relative humidity are being recorded. Fluting was assessed at trial establishment and further assessments are planned at 12, 18, and 24 months after establishment. City Forests Ltd's assistance with this trial is gratefully acknowledged.

Contact: Lindsay.Bulman@scionresearch.com

New research links for Nectria ecology

In August and September this year, Dr Anna Hopkins received funding from the Bilateral Research Activities Programme (BRAP) and spent five weeks in Sweden and Denmark working on a collaborative research project on the fungus *Neonectria fuckeliana* with scientists from two prominent Scandinavian universities. The principle aims of this research are to exchange isolates and genetic material of order to compare the behaviour of the fungus in Scandinavia (which is within its native range) and New Zealand.

'Principle aims of this research are to exchange isolates and genetic material of N. fuckeliana, to compare behaviour between Scandinavia and New Zealand

In Sweden, Anna was hosted by Dr Rimvys Vasiatis from the Swedish University of Agricultural Sciences in Uppsala while in Denmark Anna worked with Dr Iben Thomsen from Forest and Landscape Denmark, now a part of the University of Copenhagen. During the five weeks, Anna was able to access collections of isolates of *N. fuckeliana* from throughout Scandinavia and the Baltic States and use these for a number of ecological and genetic studies. In addition, she visited a large number of Norway spruce plantations throughout Denmark and Sweden and was able to make several collections of *N. fuckeliana.*

Now that Anna is back in New Zealand, the collaboration with Rimvys and Iben continues with further studies comparing the ecology and genetics of *N. fuckeliana* in Scandinavia and New Zealand. Early results indicate that the behaviour of *N. fuckeliana* is similar in Scandinavia and New Zealand. As a result, it appears likely that the high levels of disease caused by *N. fuckeliana* in New Zealand are related to the different environmental conditions, silvicultural practices and host characteristics compared with the Northern Hemisphere, rather than a change in the behaviour of the fungus itself. Further experiments are currently underway to test this.

Contact: Anna.Hopkins@scionresearch.com

Nectria infection processes

Studies by Bulman, Power and Ramsfield have demonstrated that although pruned stubs may be important for fungal infection and development of Nectria flute canker, *N. fuckeliana* can be present in unpruned trees and therefore must have more than one method for entering the stem. In late 2007, a new field trial was established to examine branch crotches as potential infection courts for *N. fuckeliana*. In this trial, selected branches on 45 trees were weighted to simulate the bending of branches by snow. This was hypothesized to create cracks in the bark of the branch crotch which may allow fungal penetration into the stem. Sources of *N. fuckeliana* inoculum were then placed above the branch crotch to simulate natural infection processes. The progress of this trial was monitored during 2008 with a final assessment and harvest due in mid-2009.

Contact: Anna.Hopkins@scionresearch.com

Whitewood Formation

Columns of white, dry wood are formed in the sapwood of many *P. radiata* stems with cankers caused by *N. fuckeliana.* The columns of dry wood, which may extend up to 2 m up the stem, are characteristically associated with infection centres (at branch whorls). These columns vary in how far they extend longitudinally and also in the tangential and radial planes. *Neonectria fuckeliana* may be readily isolated from points throughout the dry wood but in some instances is obtained only close to a pruned whorl, with the remainder of the dry column free of any colonising micro-organisms. Although this trait of white, dry wood has been previously observed in *P. radiata* the consistency with which it occurs in *N. fuckeliana*-infected stems, and the length of the columns, is considered unusual. A review conducted in 2008 sought to draw on the available information and establish likely causes for the formation of dry sapwood columns in *P. radiata* stems particularly in the context of *N. fuckeliana* infection, and to enable us to interpret its role and importance in the development of Nectria flute cankers.

Pine-pathogen systems in which gas enters the sapwood in advance of colonising fungi have been recorded, albeit infrequently. The aeration of wood inside the tree, caused by the infection process, is believed to initiate dry-wood zones. Although sapwood drying of *Pinus* spp. has been reported to occur when air enters through wounds to the internode, areas of dry wood are small and limited to proximity of the wound. Drying of sapwood around pruned branch stubs has not been reported to occur in the absence of fungal infection.

As this phenomenon does not occur in response to all fungal colonisers, and has seldom been observed in relation to physical injury alone, the way in which *N. fuckeliana* infection influences cavitation requires further investigation. Field experiments will be complemented with biochemical studies and microscopy.

Contact: Margaret.Dick@scionresearch.com

Needle-cast Disease

In 2008, work on needle diseases focussed on risk assessment and developing a research programme aimed at reducing the economic impact of needle diseases on pines. These form a significant part of the Scion FRST biosecurity programme, with work planned on improved control of Dothistroma needle blight, influence of environmental factors on severity of needle diseases, and the control of Cyclaneusma needle-cast by silvicultural manipulation.

Lindsay Bulman spent a week in September visiting forests in Austria and the Czech Republic looking at Dothistroma needle blight with 17 scientists from 10 countries. The visit was partly funded by the Bilateral Research Activities Programme (BRAP). At the end of the visit a research plan was proposed and potential sources of funding identified.

Research topics identified during discussion included monitoring and diagnostics; epidemiology (interaction with other foliar diseases, pathogen variation with regard to dothistromin production and its relationship to virulence and pathogenicity dispersal); and management (silvicultural control of disease, biological control, chemical control and host susceptibility and resistance). Potential sources of funding included a COST (Co-operation in the field of Scientific and Technical Research) action and Norway-Czech cooperation funding. A follow-up meeting is planned in mid-2009, to be held in the United Kingdom.

Contact: Lindsay.Bulman@scionresearch.com

Induced Resistance

Using fungal endophytes to induce pest resistance

Induced resistance is a novel mechanism for increasing resistance in forest systems. Stimulation factors, such as non-pathogenic microbes, can prime the host's defence mechanisms resulting in an enhanced defensive capacity. This increased resistance can significantly reduce the impact of pests and stresses that have adverse effects in forest systems, especially when integrated with other forms of control. Induced resistance has been well studied, utilised, and proved effective in agricultural crop systems. In contrast, work in the forestry sector, both within New Zealand and internationally, has been minimal.

'Previous work in another tree species showed that fungal endophytes were able to increase resistance in the host against the pathogen white pine blister rust.'

To advance our understanding of induced resistance mechanisms in forests, a research project investigating the effectiveness of non-pathogenic fungal endophytes in *Pinus radiata* was initiated. Fungal endophytes are fungi that live within their host without causing any disease symptoms. Endophytic fungi have been identified in all plant species studied to date, although the function of these endophytes within their hosts is relatively unknown. Previous work in *Pinus monticola* has shown that fungal endophytes were able to increase resistance in the host against the pathogen white pine blister rust. Thus, it is hypothesized that fungal endophytes in New Zealand's forests could function in a similar fashion.

The objective of this study was to isolate and identify fungal endophytes from foliage of *P. radiata* trees affected by Cyclaneusma needle-cast and from healthy trees in the same stands. The next step was to compare the fungal diversity and composition between the diseased and healthy trees in order to

identify any potential beneficial endophytes for future induced resistance research or endophytes that may contribute or be involved in disease expression. A total of 757 colonies of fungal endophytes were isolated from both healthy and Cyclaneusma-affected *P. radiata* trees. The composition and diversity of the fungal endophytes isolated differed between the stands sampled as well as between healthy and Cyclaneusma-affected trees. Identification of 464 of these endophytes showed they represented at least 37 distinct fungal taxa. Nine of these taxa were specific to the healthy trees only and 15 were found only in the susceptible needles sampled.

A selection of these fungal endophytes is being tested, using a variety of laboratory-based methods, for their ability to provide beneficial functions in their host plants. Further *in planta* work is required to identify fungal endophytes that could help mediate resistance against Cyclaneusma needle-cast in *P. radiata* plantations.

Contact: Rebecca.Ganley@scionresearch.com

Physiological Needle Blight

Causes of Physiological Needle Blight

Field trials established to monitor Physiological Needle Blight (PNB) and factors that may contribute to the disease have repeatedly been unsuccessful. Samples of affected needles taken over the past 20 years have not yielded any fungal pathogens. Outbreaks have often been associated with above average rainfall in June or July. Recent research has focused on the link between humidity, water relations in the plant, and PNB symptom development.

Due to the difficulties of conducting physiological experiments in the field, work has been carried out in the laboratory by Nick Gould from HortResearch (now Plant and Food Research). These experiments have led to the theory that PNB may be caused by a sudden drop in relative humidity in spring which results in cavitation in the water conducting tissue of the plant. The needles then desiccate and rapidly develop PNB symptoms of red/brown colour and droop. Older trees appear to be more vulnerable to cavitation and this would fit with the observation that PNB is more frequent in trees older than 15 years.

Contact: Lindsay.Bulman@scionresearch.com

Ectomycorrhizal Fungi

Ectomycorrhizal (ECM) fungi dramatically enhance the growth of plantation species and facilitate the establishment of nursery seedlings following out-planting. A PhD study completed in 2008 focused on investigating the ECM species associated with *Pinus radiata* and the change in their composition over time.

Contrary to international studies it was found that nursery ECM persisted and dominated in the first year of out-planting. The first non-nursery ECM, *Pezizales* sp., occurred six months after out-planting but remained in minor abundance. *Rhizopogon rubescens* was the most persistent and dominant nursery ECM species. Overall, nursery ECM survived for two years following out-planting, but were completely replaced within seven years.

The PhD study was limited to *P. radiata* seedlings grown from seed at Te Ngae Nursery in Rotorua and planted in two stands in Kaingaroa Forest. The study on the fate of nursery ECM following out-planting is now being expanded. Ongoing research will investigate the fungal associates of *P. radiata* and Douglas-fir, given that ECM species vary between these hosts. As soil conditions are another important factor influencing the presence of some ECM, the current project will include several nurseries across the country, covering a range of soil conditions.

Lastly, we are studying planting stock grown from seed, cuttings and root trainers to determine whether different methods of propagation influence the composition of ECM present in the nursery immediately after out-planting. The industry may be losing revenue from reduced seedling vigour and growth loss, due to lack of ECM. This project aims to determine the relationship between planting stock vigour and ECM.

Contact: Katrin.Walbert@scionresearch.com

Reducing Pesticide Sprays

Improving Dothistroma control

The New Zealand forest industry spends around $2.5 million per year on Dothistroma control by aerial application of copper in a mixture of oil and water. There have been many advances in copper product formulation and spray technology over the past 20 years, creating ongoing opportunities to improve application methods and reduce costs.

The success of copper application to control Dothistroma needle blight depends on efficient spray deposition on pine needles and durability of the copper on the foliage when copper is exposed to rainfall, sunlight, and abrasion. A research project to investigate methods for improving operational effectiveness of aerial spraying to control Dothistroma needle blight has provided useful results.

This project provided the following important findings:

1. Copper persistence and droplet spread can be maximised by increasing the concentration of oil in the spray mix.
2. Copper persistence with high oil concentrations is improved by reducing total spray volumes from 5 l/ha to 3 l/ha.

The cost of aerial copper application contributes between 40% and 60% of the total cost per hectare. Therefore a reduction in application volume from 5 l/ha to 3 l/ha will reduce costs more than reducing copper rates.

A pot trial and droplet spectra tests showed that volume reductions can be gained using a range of fungicides and oils, while still maintaining spray performance in terms of flow-rate through the nozzle and meeting droplet size criteria.

Field studies are required to confirm these potential benefits.

Reports from these trials have been posted on the FBRC website (www.fbrc.org.nz).

Contact: Stefan.Gous@scionresearch.com

Biological Control of Gumleaf Skeletoniser

Gumleaf skeletoniser *(Uraba lugens)*, a potentially serious defoliator of eucalypts in New Zealand, is an Australian species first found here in 1992 at Mt Maunganui in the Bay of Plenty. It is now widespread in Auckland and has now been found in Waikato and Coromandel. In February 2008 it reappeared at Mt Maunganui, where it has not been seen since an eradication effort in the late 1990s. Given time it can spread to all parts of New Zealand where eucalypts are grown.

Biological control for this pest is under development, supported by a Sustainable Farming Fund (SFF) grant. The Australian parasitoid *Cotesia urabae* is currently undergoing host range testing in Scion's quarantine facility to gather evidence for an application to the Environmental Risk Management Authority (ERMA) for its introduction against gumleaf skeletoniser. Significant progress has been made on this intricate series of experiments during 2008, and the laboratory work is expected to finish by mid-2009. A request to extend the project timeline by one year has been approved by the SFF.

As part of this project Dr Lisa Berndt was awarded Scion sabbatical funds for a trip to Tasmania in December 2008 to develop collaborations with Dr Geoff Allen at the University of Tasmania. For a number of years Dr Allen has been supplying Scion with shipments of the parasitoid *C. urabae*. The trip to Tasmania enabled Lisa to see the pest and parasitoid in their natural environment, and to work with Dr Allen and an Honours student to design experiments to explore host selection by the parasitoid to further support the ERMA application.

Contact: Lisa.Berndt@scionresearch.com

Reducing Sapstain in Windthrown Trees

Windthrown radiata pine is highly susceptible to fungal attack by sapstain and decay fungi, and there is a limited window of opportunity for salvage harvesting. Bark beetles and wood borers also play an important role as vectors of fungal spores by tunnelling in the phloem and sapwood. Depending on the climatic conditions it may only take weeks before the logs are so degraded that they are no longer merchantable.

A new FBRC project seeks to better understand the risk of insect and fungal attack at different times of the year. This project has begun by assessing the attack by bark beetles and wood borers, as well as the development of sapstain and decay fungi, using trees in the Nelson region that were damaged by wind and snow in August 2008.

In 2009, an MSc student, James McCarthy, will carry out work on colonisation of wind thrown trees in Nelson. Scion will be responsible for funding the work, along with the FHRC.

Further studies will involve felling additional trees to mimic windthrow and monitor attack by insects and fungi and their development in a more controlled fashion at regular intervals over the whole year.

Contact: Eckehard.Brockerhoff@scionresearch.com

Reducing Methyl Bromide Use in New Zealand

Methyl bromide is used for quarantine treatment of export pine logs and sawn timber from New Zealand. There is growing opposition to continued methyl bromide use due to environmental and public health concerns. At the same time methyl bromide for quarantine pre-shipment use is increasing as export of logs and sawn timber grows.

Efforts to find a solution to this urgent problem have gained momentum over the past year, with support from the FBRC and STIMBR (Stakeholders in Methyl Bromide Reduction). Forest Industries Development Agenda (FIDA) funding in 2008 provided an essential leverage component of a much larger programme involving Sustainable Farming Fund and STIMBR contributions.

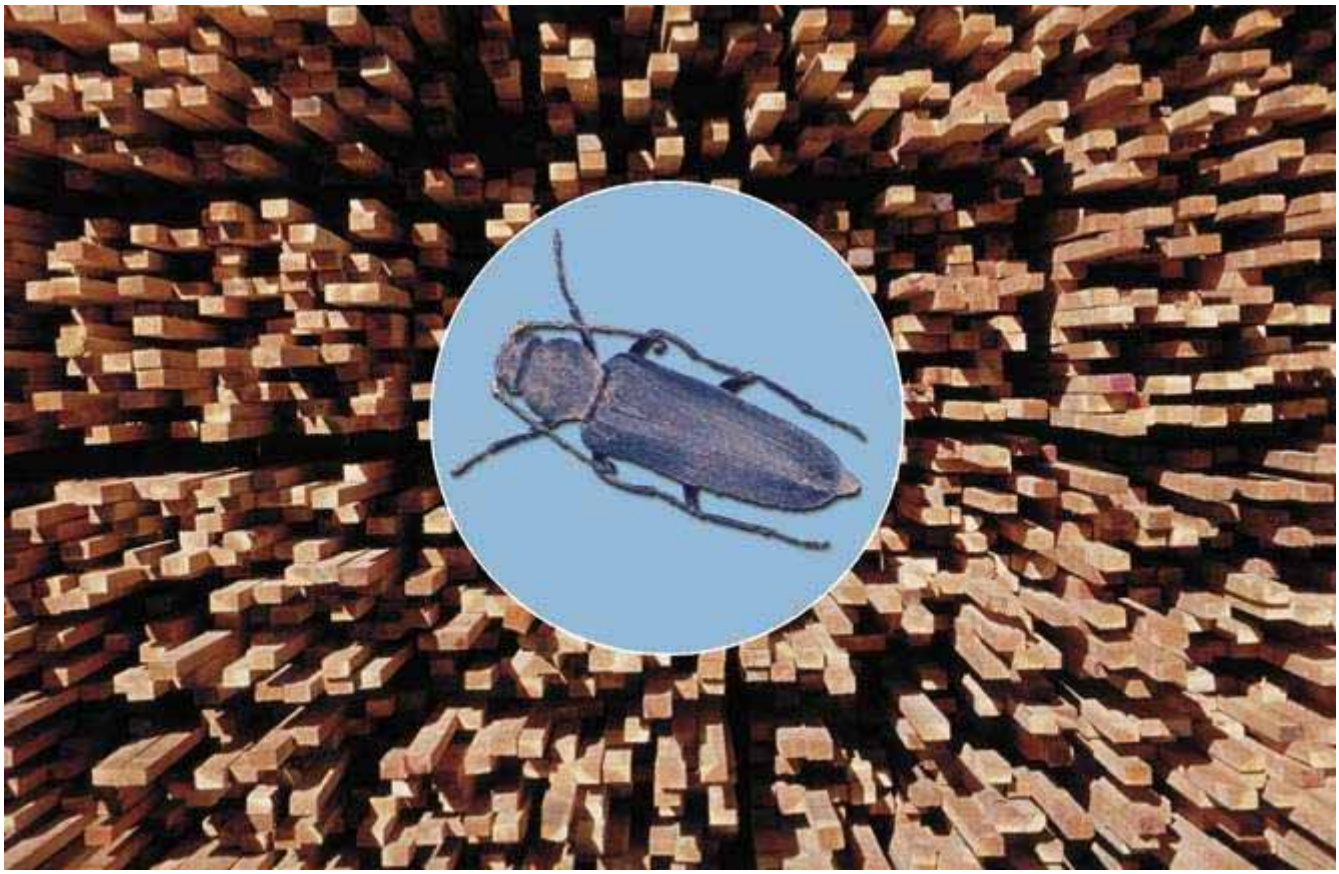
Solid groundwork has been laid in three key areas over the past year, setting the stage for further progress in the next two years of the project.

Recycling methyl bromide - Options are being evaluated for the recapture, reuse, and/or destruction of methyl bromide for large scale fumigations. This technology may have application for export logs and timber.

Identifying replacement fumigants - All research involving phosphine as a replacement for methyl bromide has been reviewed and consolidated.

The export protocol for New Zealand's log trade to China stipulates disinfestation using 'in-transit' phosphine treatment with 200 ppm phosphine for 10 days for control of quarantine pests such as *Hylastes ater* and *Arhopalus tristis.* This treatment is used for 'in-hold' logs, is cost-effective and is a viable alternative to methyl bromide.

Previous research showed that 200 ppm phosphine for 10 days was effective for control of *Arhopalus* eggs and adults and *Hylastes* larvae and adults.



Subsequent research and commercial experience suggests that the minimum phosphine treatment duration may be shorter than the 10 days required at present. Efforts are now under way to better define the minimum phosphine treatment for logs and for sawn timber.

Reducing fumigants through other means - Trials have been completed at a major timber mill and within a forest to find ways of reducing *Arhopalus* contamination of export sawn timber. Methods under investigation involve insect-proofed timber pallet wrapping and modifications to the site environment using lights of different colours. This type of multi-pronged approach could ultimately provide a safe pathway for export of sawn timber without the need for fumigation.

Insects are known to be strongly attracted to ultra-violet light and much less attracted to other regions of the visible spectrum. Scientists propose to take advantage of this differential attraction to different coloured lights to reduce the number of insects congregating at mill sites.

Trials show that ultra-violet light captures considerably more than *Arhopalus* than the least attractive colour, yellow light. Metal halide (white light) and both high and low-pressure sodium (two yellow lights) were tested to determine which attracted the fewest individuals. Both yellow lights tested attracted no more individual beetles than the no-light control treatment.

'The export protocol for New Zealand's log trade to China stipulates disinfestation treatment for control of quarantine pests such as Hylastes ater and Arhopalus'.

Ultra-violet traps were shown to be effective in capturing individuals that did enter the site. The results show that visual cues can be used strategically to reduce insect populations on a site.

Additional lighting trials are now planned at a sawmill scale and will incorporate the use of insecticide-treated pallet wrappings.

Contact: Gordon.Hosking@xtra.co.nz or Steve.Pawson@scionresearch.com

Development of Beneficial Microbe Application Kits for Forest Nurseries

Concrete mixer used to coat *P. radiata* seed at PF Olsen Nursery

A prototype kit, suitable for coating *Pinus radiata* seed with selected beneficial microbes by forest nurseries, has been developed and tested. ArborGuard™ was successfully applied to the 2008/09 seed crop sown at the PF Olsen Nursery (Waiuku). Several different *Trichoderma* isolates were applied to pine seed for trials at the Timberlands Te Ngae Nursery (Rotorua). A concrete mixer was used for coating large batches of stratified seed (c10 kg) and a small hand operated mixer for smaller quantities (1 – 5 kg). Very small quantities (several grammes) were also coated using polythene bags.

The suitability and compatibility of mixtures of selected *Trichoderma* isolates and isolates of entomopathogenic fungi are currently being evaluated, applied as seed coatings.

ArborGuard™ - coated pine seed drying on screen

Contact: Robert.Hill@lincoln.ac.nz

Phytophthora root rot control

Trials of *Trichoderma* for the control of Phytophthora root rot in bare-rooted radiata pine seedlings are continuing at Te Ngae Nursery. The trial area is naturally infested with the root-rot pathogen and suffered over 30% losses to the disease during 2006. Seed coatings of *Trichoderma* and applications of phosphorous acid during the season resulted in greater disease suppression than that supplied by the traditional chemical.

Contact: TReglinski@hortresearch.co.nz

Enhancing root initiation, health and vigour of *P. radiata* cuttings

The Bio-Protection Centre research group has screened over 60 *Trichoderma* isolates for their ability to enhance root development and establishment of cuttings. This work aims to find a product which will benefit the forestry, horticultural and nursery industries. Willow was chosen as an initial model system, primarily because it produces roots easily and quickly. Root development was compared to untreated controls and various commercially available rooting products. Three *Trichoderma* isolates gave outstanding promotion of roots compared to any of the other treatments and a number of other isolates also provided promising results. A selection of the best isolates will be tested to examine their potential to enhance rooting of cuttings over a wider range of plant species under varying conditions.

The best isolates from this screening trial will now be tested on *P. radiata* cuttings at the PF Olsen and Te Ngae nurseries in 2009.

Contact: Robert.Hill@lincoln.ac.nz

Armillaria disease forestry trials

The *Trichoderma* vs *Armillaria* forest plantation trials at Kinleith and Kaingaroa, established in 2001, will be assessed for tree health, mortality and for growth in May 2009. The Rotoiti forest trial, established in 2007, was assessed in May 2008. Over 7,000 trees were evaluated for health and mortality. The ArborGuard™ treatment had the highest health score and lowest mortality from Armillaria disease. This trial will be re-assessed in 2009.

Bio-Protection of *Acacia mangium* using Trichoderma in the Planted Forest Zone, Sarawak

Enhanced growth with *Trichoderma* visible

Trichoderma - treated *Acacia mangium* seedlings (right) vs untreated control (left).

The success of the New Zealand forestry bio-protection research has led to a collaborative partnership between the Bio-Protection Research Centre, Lincoln University, Sarawak Planted Forests Sdn Bhd and Grand Perfect Sdn Bhd in the Planted Forest Zone of Sarawak, Malaysia. Dr Hill has been contracted as a consultant to lead a two-stage project: firstly to enhance *Acacia mangium* seedling establishment, growth and health in the forest nursery and secondly to control *Ganoderma* root rot disease in plantation forests using selected local *Trichoderma* isolates.

Using selected local Trichoderma isolates, ten forest nursery trials, with 12 treatments per trial, were established at the Samarakan nursery between August and December 2008. The best *Trichoderma* treatments increased seedling growth and vigour and reduced disease incidence, without the use any fungicide sprays. We plan a large-scale validation of the best *Trichoderma* treatments in the forest nursery in the first quarter of 2009, followed by pilot-scale forestry plantation trials (vs Ganoderma disease), in mid-2009.

The Planted Forests Project has been named as one of the six most important research projects in the world by Discover Magazine.

www.fbrc.org.nz

For more information on FBRC, membership details and science reports.

Representative Contacts:

NZ Forest Owners' Association

David Balfour (Chairman) - david.balfour@tll.co.nz
Wei Young Wang - wei-young.wang@pfolsen.co.nz
Nigel Heron - nigel.heron@tll.co.nz

MAF Biosecurity New Zealand

Paul Stevens - paul.stevens@maf.govt.nz

NZ Forest Health Collaborative

Mark Forward - mark.forward@nelsonforests.com

Scion

Brian Richardson - brian.richardson@scionresearch.com

Lindsay Bulman - lindsay.bulman@scionresearch.com

Bio-Protection Research Centre, Lincoln University

Robert Hill - Robert.Hill@lincoln.ac.nz

Radiata Pine Breeding Company Ltd

John Butcher - john.butcher@rpbc.co.nz

FBRC Administrator

Don Hammond - don@hrml.co.nz

Forest Biosecurity
Research Council