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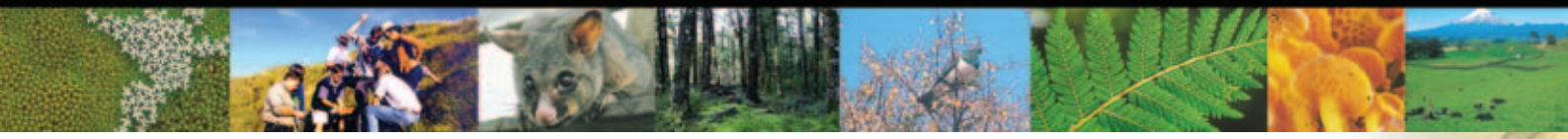
Landcare Research

Landcare Research
DISCOVERY



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What's Inside:

Ideas • Innovation • Investment

These are the three components of the Government's strategy to ensure that research, science and technology provide the full range of benefits to New Zealand.

In terms of ideas and innovation, New Zealand does well, producing plenty of high quality science. However, we are generally not so good at generating commercial prospects and investment from that science, an area on which the Government has a strong focus to improve New Zealand's economic performance. The budget announcement of the new Pre-Seed Accelerator Fund to accelerate the commercialisation of publicly funded research is evidence of that commitment.

So the challenge is turning great science into wealth and wellbeing for New Zealand.

Landcare Research is part of that challenge and some recent changes in the organisation reflect this. My new role as Chief Operating Officer, Commercialisation will ensure that there is clear focus on commercial development, where this is appropriate, and that strong relationships are built with the commercial sector. This will mirror the way that Landcare Research has built good working relationships with those in the conservation and sustainable development sectors in the past.

Some of our commercialisation projects will be designed and planned for a specific outcome; others will undoubtedly come from the most unexpected places. Developing the skills to recognise and evaluate the opportunities and nurture them through a sometimes complex development process is part of the learning that we will need to go through as an organisation. We should not underestimate this task or be impatient, as all the international experience tells us that it takes time. On the positive side, I have already met many talented and innovative people working in this area and there is a whole new skill base developing. I know that we are in good company as we travel down this path. Many other organisations in New Zealand have the same challenges and at a global level other economies have faced similar issues and succeeded. New Zealand will too.

Some of our commercial projects and partnerships are profiled in this issue of *Discovery*.

Mark Cleaver

Chief Operating Officer, Commercialisation

Landcare Research

Photo credits: left to right, Harley Betts 1, 2, 6, 8, Dave Morgan 3, Landcare Research Slide Collection 4, 5, Peter Buchanan 7.

Lean, 'green' building sets power-saving example

While the recent power crisis has alerted New Zealanders to the need for energy conservation, Landcare Research's energy-efficient 'green' building currently under construction is forecast to use just half the power of a regular office building.

The building, on Auckland University's Tamaki campus, is scheduled for completion toward the end of the year. The three-storey building will house about 90 staff, from both Landcare Research and the Ministry of Agriculture and Forestry. It will also become the new home for about 6.5 million insects in the New Zealand Arthropod Collection, and about 65,000 fungal specimens in the New Zealand Fungal Herbarium (PDD).

Landcare Research Operations Manager Maggie Lawton says the power savings will come despite the high energy requirements of keeping the collections and laboratories at the cool temperatures and low humidity required.

"In fact, the laboratories will use only a third of the power of regular laboratories.

"We forecast that we will save many thousands of dollars in electricity charges over the coming years. The building will also catch rainwater from the roof detaining about 150,000 litres in storage tanks. This will save us at least $3,000 a year in water charges."

Chow Hill Architects was selected as principal design consultant. "Part of our brief was to demonstrate that a 'green building' can be constructed at comparable cost to an ordinary building," says project director Maurice Kiely. "Also, the building will have a relatively conventional outward appearance, with features that can easily be used in other sites and building types. It is proof positive that a building does not have to be 'strange' or 'wacky' to be green."

Mr Kiely says five key design principles form the foundation of the building's success.

"Firstly, the building is oriented to enhance shading from the sun, and to minimise heat gain at the hottest times of day. It is a narrow building with a high mass, and both of these features help to retain a stable temperature inside. The building shape allows natural light and air to get in. The building is also highly insulated, with carefully chosen materials for the walls and façade, and double glazed windows. Additionally,

Chow Hill Architects

Computer generated image of the northern aspect of the new "green" Landcare Research building being built on the Auckland University Campus.

Chow Hill Architects

Computer generated image of the north-eastern aspect of the building.

materials have minimal finishing, and are locally sourced wherever possible.

"These factors combine to make the building as sustainable as any building in Australasia, based on recognised performance indicators," says Mr Kiely.

Engineers from Connell Mott MacDonald designed many of the energy and water-saving features. "We obtained climate data for Auckland, so we could look at light angles and intensity and temperatures for any time of day, and any day of the year," says the company's head of mechanical services, Neil Purdie. "We used that information to create computer models of daylight levels in the building, and help select a design and materials to optimise ambient light and heat storage."

Connell Mott MacDonald also used climate data to decide the capacity of the rainwater tanks to provide enough water for use in the building and greenhouses. The water will be heated by solar power and used in hand basins and water heaters throughout the building. Waste heating from freezer and refrigerating systems will be recovered to help heat the water.

The rainwater will also be used for flushing the urinals and 'conventional' toilets on the ground floor (composting toilets will be installed on the first and second floors). A windmill will pump water to the top of the roof for flushing purposes, when needed.

Special gardens and soak holes will absorb any excess water. The amount of water entering the stormwater system is greatly reduced.

On a different note, the building has been designed to be more earthquake resistant than regular buildings, because of the irreplaceable (and heavy) collections it houses. It is designed to withstand a one in 600 year earthquake.

Mr Purdie says as an engineer, the project offered exciting opportunities to design and test new technologies. "It has also been very refreshing to work with such technologically informed clients.

"All in all, the building sets a benchmark for sustainability. We hope that it inspires others to build with similar concepts in mind. Environmentally sustainable buildings not only help to save power, they help in a range of ways to improve our urban environments."

Funding: Landcare Research

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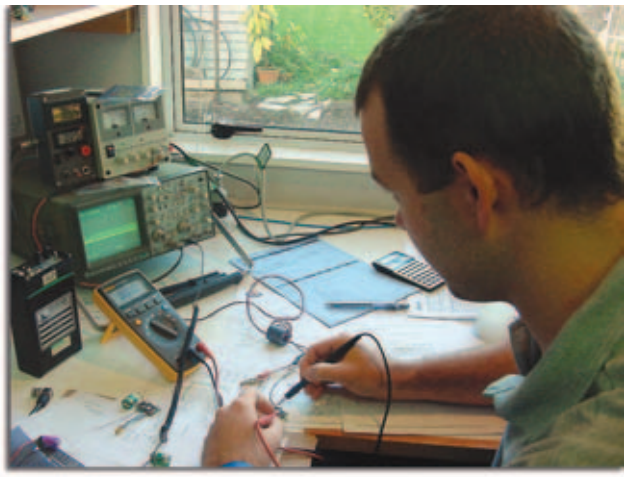
Chow Hill Architects

Computer generated image of the southern aspect of the building, as seen from Auckland University's Ring Road.

'Contact logger' to record close animal encounters

An innovative device designed in New Zealand to log interactions between animals is being trialled in the United States, in a study on the spread of rabies among raccoons.

The 'contact logger' was invented by staff at Sirtrack Ltd, a subsidiary company of Landcare Research that designs and manufactures wildlife tracking equipment for use on birds and animals. These devices can be used to measure activity, mortality (indicating when an animal has died), heart rate, temperature and sound. The new contact logger acts as a proximity detector, recording when animals come within a prescribed distance of each other.



Dave Ward

Sirtrack technician Simon Klaus, testing the contact logger before it is sent to the USA.

Dave Ward

The contact logger, packaged into a raccoon-size collar.

Sirtrack Manager Dave Ward says the information the contact logger gathers is important for agencies wanting to know more about the spread of disease through a population.

"We have had interest from agencies concerned about the spread of Bovine Tb in badgers in the UK, and deer and possums in New Zealand. But the main driver is a team from the Max McGraw Wildlife Foundation in Illinois. Raccoons are vectors for rabies, which can also be passed on to humans. The Foundation wants data on contact between raccoons, to help construct a computer model of the expected spread of the disease into Illinois.

"We sent them 10 prototype devices which fit onto raccoon-size collars. These will show how often raccoons come within a set distance of each other.

"The devices can also be used to detect the presence or absence of animals at nest sites, dens and other places of interest, and record how often individual animals pass by fixed points."

Mr Ward says each device will broadcast a unique ID code, while simultaneously listening for others.

"If another ID code is detected it means another animal has come within range. The receiving unit records the time this happened, and the ID code of the transmitting unit. The other unit is also listening, and does the same.

"We have anticipated the problem of a 'memory flood' occurring when animals den together, or come into contact with three or more other animals at once. The units are pre-programmed to cope with this.

"Additionally, the devices contain a standard radio transmitter. Therefore, we can go and find the animal and retrieve its collar if we need to."

Once retrieved, the contact logger can be plugged into a computer and the data downloaded.

"Further refinements are possible depending on market demand. Instead of being plugged into a computer, the loggers could transmit their proximity data by radio waves, or even via satellite."

Mr Ward says just as the prototype contact loggers were customised for the raccoon study, devices made in future will also be customised. "They will have different sizes and different battery weights, depending on the animal concerned. They will also be programmed to detect proximity at different distances, up to several hundred metres."

The contact loggers will be exhibited at the Wildlife Management Congress (hosted in part by Landcare Research) at the University of Canterbury, December 1-5.

Funding: Sirtrack Ltd

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Researchers measure growth of native youngsters

Twelve popular native plant species are being studied to better understand their growth rates as young plants.

Four years into the ground-breaking (and at times, back-breaking) project, the findings are providing valuable information to those wishing to re-establish native trees in riverside areas, and/or improve riverbank stability.

The 12 species are those commonly found in riverbank areas. They are: cabbage trees, lemonwood, kōwhai, ribbonwood, lacebark, mānuka, tutu, karamū, māpou, kōhūhū, rewarewa and five-finger. More than 60 seedlings of each species were randomly planted on a river terrace at Gisborne's Tairāwhiti Polytechnic. Each year, ten plants of each species have been carefully extracted for measurement using an air lance to minimise damage to their root systems.

Landcare Research scientist Dr Mike Marden says growth rates have soared. "Until the trees were two, only modest growth occurred. Now, most trees are displaying a dramatic increase in their annual growth rate.

"Getting them out of the ground can be back-breaking, and the amount of work required to partition and measure foliage, branches, stems and roots back in the laboratory is mind boggling. Because there was no precedent, we had no idea how quickly these trees would grow or how demanding this work would be.

"Now, for the first time, we are getting an insight into above- and below-ground differences in growth performance between species during their early years."

Dr Marden says these insights are already proving useful. "For example, I thought I had allowed ample growing space for the trees, but in fact I underestimated their requirements.

"Each time we dig up a tree we find its roots have overlapped with others, sometimes by several metres.

"If people want individual trees to thrive, they should plant them much further apart than they may have planned. However, if they want the roots to knit together to help stabilise eroding stream banks, close plantings may be desirable."

Mike Marden

Gisborne technician Donna Rowan using an air lance to extract the roots of a four year old tutu.

Dr Marden says overall, ribbonwood, cabbage trees and tutu were the best performers.

"Within four years these have attained the best balance between above-ground growth, root volume and soil occupancy. It is these attributes that may ultimately assist with the design of restoration and rehabilitation projects."

Landcare Research scientist Dr Chris Phillips says most of the 12 species are shallow rooted, and have about 20% of their living weight or 'biomass' under the ground. "However, ribbonwood and tutu have more extensive root systems, with about a third of their biomass underground. If you want to avoid using willow trees and/or help promote the resurgence of native trees, these two species will help to stabilise your soil.

"Roots in soil are just like steel bars in concrete – they provide additional strength by their reinforcing action."

The research into their growth rates is also providing essential information from a greenhouse gas perspective, as Landcare Research scientist Dr Craig Trotter explains.

"We have had very little information on the growth rates of New Zealand shrubland species which, under the Kyoto Protocol, may become important for storing carbon. We need to calculate carbon storage in vegetation and report on it every five years. By knowing the area of different shrubland types from vegetation maps, and their growth rates, reporting becomes an inexpensive desk-exercise.

"The role of these plants in preventing soil erosion has carbon consequences as well. Eroded soil releases CO_2 to the atmosphere, as it moves from hill slopes to the sea. This can count against us in Kyoto calculations."

The project will continue for one further year. Meanwhile, Drs Marden and Phillips have been discussing the information gained so far with interested end-user groups.

Funding: FRST (Foundation for Research, Science and Technology)

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Dr Mike Marden with a cabbage tree on the trial site.

Air pollution research tackles big questions on small particles

Work by Landcare Research is helping to define the size of the health threat in urban skies by measuring tiny air pollution particles—particles so tiny, they have escaped accurate measurement in the past.

Toxic particles in polluted air are known to cause disease, although much is yet to be learned about which diseases are caused by which particles. The very smallest particles are believed to be the most dangerous, as they infiltrate to the deepest part of the lung. Landcare Research scientists studied Christchurch air because of the city's notorious smog problem and 'high pollution nights'. Environment Canterbury tests show the city exceeds the national maximum PM10 levels about 30 times each winter. The PM10 levels refer to particles with a diameter of less than 10µm, which are easily inhaled into the deep lung.

Julian Myers-Poulsen, The Press.

Christchurch's notorious smog, winter 1999.

Landcare Research scientist Dr Janine Clemons led the project. Dr Clemons says before her research, air pollution particles had only been measured by weight to air volume (µg/m^3). "However, this method was skewed towards detecting the heavier, non-toxic particles, such as salt particles from sea air. We wanted to know more about any toxic particles present. We wanted to know their size, shape, surface area, number and origin."

With the help of two collaborators from Cardiff University in Wales, Dr Clemons sampled winter air in Christchurch and Dunedin for two weeks each in August 2001. The group used filters that 'vacuumed' particles out of the air, and changed the filters every two hours throughout the day and night. They also used 24-hour filters.

All the particles on the filters were examined using electron microscopy at the National History Museum in London. The particles were coated with gold and carbon, and electrons were 'fired' at them to produce visual representations, and to enable them to be counted and measured using a computer programme. The process provided valuable information that had not previously been available through weight measurements alone.

"We found that soot particles made up three quarters of the total number of particles in all filters," Dr Clemons says. "These particles can stem from the products from combustion, for example smoke, exhaust fumes and fly ash. As expected, we found that the readings were higher in the morning and at night.

"We saw, to our surprise, that there were some similarities between the night-time filters and filters from a smoker's home. The particles looked 'stickier', with more resin-like surfaces, not unlike the tar of cigarette smoke."

The scientists also found that the particles in the filters were well below 10µm.

"We found that they were all less than 2µm in size, with most of the toxic soot particles less than 0.1µm. Previously there was little understanding of size distribution, with most monitoring based on the weight of the particles.

'Therefore, we now have much more accurate information."

So what does all this mean for the health of Christchurch citizens?

"We know that the particles are harmful to human health," Dr Clemons says. "Our research has taught us more about the distribution, origins and size of these particles.

"However, further medical information is needed on which characteristics besides size make particles harmful to humans, and which particles are the *most* harmful.

"Until researchers find some answers to these questions, any environmental policies designed to reduce the effects of air pollution on human health may not be accurate or even appropriate."

Further research into the constituents of fine particles is currently being undertaken by Environment Canterbury. Dr Clemons' research supports Environment Canterbury's findings that the majority of particles discharged during the wintertime are less than 2.5µm in size and are primarily produced by combustion. Her research has provided visual representation of particles by type and may provide valuable information regarding the physical mechanisms responsible for associated adverse health effects.

Funding: NSOF (Non Specific Output Funding), Commonwealth Science Fund

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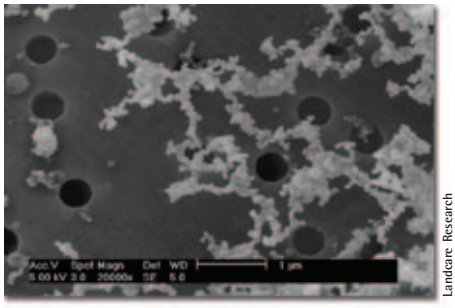


Landcare Research

Scanning Electron Micrograph of particles on a filter background. The holes are part of the filter and are 0.66µm in diameter. The particles are agglomerated and in chain form, typical of urban air pollution. Magnification: 20,000x.

Award-winning classification system goes multi-media

You've read the books; now try the CDs...

LENZ (Land Environments of New Zealand) is a unique system that represents a paradigm shift from traditional geographic classifications. LENZ identifies environments that share similar climate, soil and landforms, regardless of where they occur. It hierarchically classifies our environments at four different levels, from 20 to 500 groups nationally. Using this unique approach, enquirers can find answers to diverse questions including: Where are New Zealand's most threatened ecosystems? Can a Martinborough vineyard grow the same grapes as Bordeaux? Where could New Zealand's native mistletoe be found? How far could the deadly southern saltmarsh mosquito spread?

In June, Environment Minister Marian Hobbs launched the two LENZ books. One, a full-colour atlas for general use, provides a comprehensive background to the classification and describes and maps the units that make up the first two classification levels - 20 environments in Level I and 100 environments in Level II. The other book is a technical guide containing details of how the classification was produced, and descriptions of the more detailed classification levels, which contain 200 and 500 units nationally.

The two CDs accompanying the books contain digital copies of LENZ data. One has the four classification levels and the other has the underlying data used to define them. The principal author of the books and CDs, LENZ research scientist John Leathwick, says the books explain what LENZ does, and outline some of the insights LENZ offers. The CDs are the operating arm of the system.

"The CDs install digital data sets into your computer, with layers of information that you can view and analyse through a GIS system. If, for example, you were interested in the distribution of alpine plants on limestone cliffs, LENZ digital data sets will help you identify sites where these plants are most likely to occur.

"The data layers in the CD are built on 20 years of research on climate, landform and soil variables, including temperature, solar radiation, rainfall, soil fertility, drainage and slope. Because they map areas of land that have similar environmental conditions regardless of where they occur in New Zealand, users can see where similar ecosystems occur, and use the data to make sound environmental management decisions.

"LENZ is a whole new way of looking at environmental data. It is already gaining strong usage from the Department of Conservation. It is a superb example of what can be achieved by collaboration between a Crown Research Institute and Central Government."

Environment minister Marian Hobbs has praised LENZ. "The resource will be invaluable to those involved in the conservation and restoration of native ecosystems, resource management, environmental risk management and biosecurity, and productive land uses such as agriculture and forestry," Ms Hobbs says.

"People who work in conservation, farming, forestry, horticulture, public health and local government resource management can all use this system.

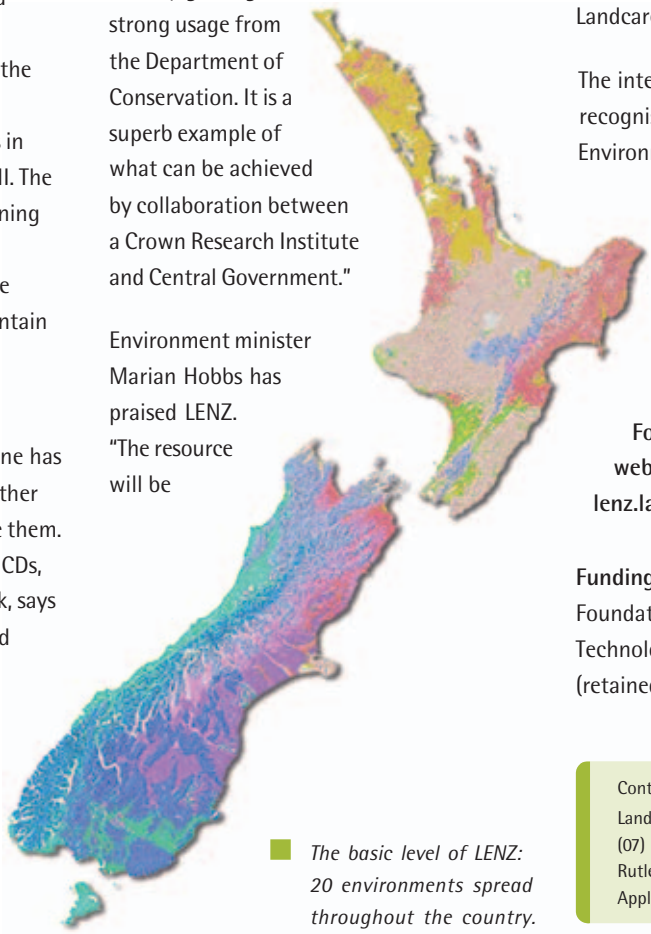
"The challenge for conservation and resource managers is to use the resource with an open mind, and explore the range of applications beyond the Ministry's environmental reporting needs."

Ms Hobbs says internationally, LENZ is a first and represents a significant achievement for the Ministry for the Environment and Landcare Research.

The international significance of LENZ was recognised at the 22nd annual Environmental Science Research Institute (ESRI) conference in San Diego in 2002, where it won two major awards including Best Analytical Application, and Best Overall Map Gallery Poster.

For more information, visit the LENZ website: http://lenz.landcareresearch.co.nz/

Funding: Ministry for the Environment, Foundation for Research, Science and Technology (FRST), Landcare Research (retained earnings)



The basic level of LENZ: 20 environments spread throughout the country.

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Scientists gain ground in battle to stop the rot

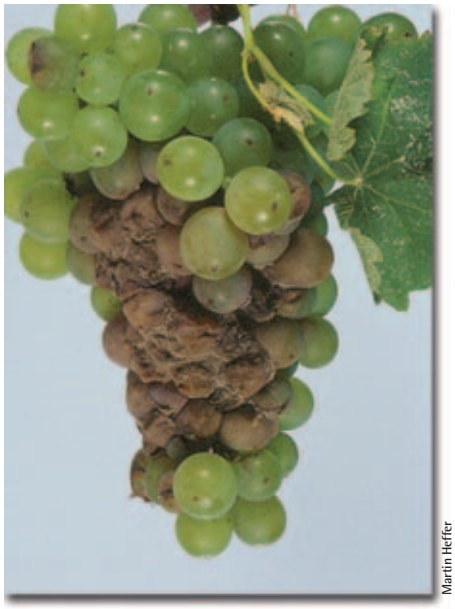
Just as time makes a wine, patient and painstaking research is making progress in the battle against a major grape disease.

Landcare Research and biotechnology company Genesis Research and Development have identified promising molecules in their quest to develop a non-GM control for use on grapes, and potentially other crops affected by the fungus botrytis.

Botrytis (*Botrytis cinerea*) is a major fungal pathogen of grapes, causing 'grey mould' or 'bunch rot'. It is prized for the characteristic flavour it imparts to dessert wines, but in most instances presents a major problem, costing New Zealand's wine industry about $30 million a year. Currently, synthetic fungicides are most commonly used to combat botrytis. However, there is consumer unease about the residues of these synthetic chemicals, and botrytis has become resistant to some of the most effective products.

Landcare Research and Genesis joined forces to find an alternative, and are building a genetic database of the fungus, to be mined for components that control cell growth. The ultimate aim is a product that interferes with cell growth, or causes cell death, reducing the need for repeat applications of synthetic fungicides. Landcare Research scientist Dr Ross Beever has worked on botrytis for 20 years, and is an expert on fungal biology. Dr Beever says several candidate processes have been identified from the genetic components.

"We are focussing on biochemical processes unique to fungi and looking for ways to interfere with them. Landcare Research is devising ways to measure these effects.



Martin Heffer

Grape bunch rot caused by Botrytis cinerea

"As we progress, we learn still more about the genetic structure of botrytis."

In the meantime, Genesis is continuing the daunting task of building up the database. "The DNA in botrytis is estimated to code for about 15,000 genes," Dr Beever says.

"We have information on more than 5,000 genes so far. "It is not easy to find useful molecules among all this information. The key is to link our understanding of how the fungus functions with the genes that control these functions.

"To assist in the task, we are able to make use of DNA databases that are being developed for other fungi including other plant pathogens and fungi that cause animal diseases. In turn, information we discover about botrytis may give insights into new ways to control these other fungi.

Landcare Research's Chief Operating Officer, Commercialisation, Mark Cleaver, says the joint venture with Genesis is a useful blending of skills.

"Genesis has excellent genomic skills and we have expertise in fungal biology. In a country the size of New Zealand, it makes sense to pool these resources, rather than duplicate them.

"The joint venture has been highly productive, and confirms that we can work successfully together. We expect that the commercial outcomes will be positive and we will deliver resources back into New Zealand's innovation system."

Genesis Plant Division Business Development Manager, Dr Neil Domigan, agrees.

"Scientists from the two companies are making a significant contribution to the project and showing excellent collaboration to solve challenging problems."

Funding: Landcare Research (retained earnings), Genesis Research and Development

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