Food and Agriculture

PARTNER ECONOMY: **THE NETHERLANDS**
ORGANISATION: **THE UNIVERSITY OF NEWCASTLE**

INNOVATION STORY

2016 PRIMING GRANTS

DR ZAMIRA GIBB

Many pre-teens dream of a career caring for horses. And this dream came true for The University of Newcastle's Dr Zamira Gibb, a horse fertility researcher who spent her teenage years riding horses in the Blue Mountains. But she says it wasn't until she began studying animal science at university that she felt passionate about reproduction.

"We're reproductive biologists, we know what we do is hilarious," she says.

"But sperm cells are interesting to work with because they're motile. They swim and move and are they respond immediately to things you expose them to."

Dr Gibb helps boost the fertility rate of thoroughbred (race horses) and standardbred (harness racers) horses, and works closely with all factions of the horse breeding industry. Thoroughbred horses are bred naturally – no artificial insemination or embryo transfers are allowed to be used. Standardbreds, on the other hand, are almost always artificially bred.

For standardbred horses, Dr Gibb and her colleagues are developing novel techniques to improve their fertility rate that artificially replicates what happens in the female reproductive tract.

One technique they are using involves the development of new semen extenders which can preserve sperm for over a week at room temperature. This means semen doesn't have to be frozen for preservation, and sperm can stay healthy for longer.

Dr Gibb adds that this new semen extender is a "biosecurity relief" since it doesn't contain any animal derived proteins such as those from egg yolk or milk.

"It also means they won't have to import so many stallions from the northern hemisphere, which is another reduction in biosecurity risk."

For thoroughbred horses, however, breeding must adopt a different approach, with management strategies, diagnostic techniques and nutritional interventions.

And as a recipient of a Priming Grant, Dr Gibb collaborated with Dr Patrick Brogan from an SME in the Netherlands, Equiception BV, and coordinated the development of novel diagnostic techniques for sub-fertile stallions through the use of emerging research tools such as ICSI.

ICSI (intracytoplasmic sperm injection) is when a mare's egg is injected with a stallion's sperm.

By working alongside commercial clinics such as Equiception BV, who are involved in many ICSI procedures, they can observe how a horse embryo develops and identify why early embryo death is so common.

Dr Gibb says they can take the information back to the thoroughbred industry to characterise the sperm of stallions who have low fertility rates.

"It's really good for management strategy and will be very valuable for stallion owners to know."

Dr Gibb is widely recognised for her innovative work on horse breeding. She was recently a finalist in the Society for Reproductive Biology's Newcastle Emerging Leaders Award, and was a keynote plenary speaker at the 2016 International Symposium on Stallion Reproduction, which takes place every four years.

Food and Agriculture

PARTNER ECONOMY: **FRANCE**
ORGANISATION: **CSIRO**

INNOVATION STORY

2016 PRIMING GRANTS

DR SCOTT CHAPMAN

From engineering to biology, working in agricultural science requires a breadth of knowledge across different scientific disciplines to meet challenges such as impending droughts, food security and potential diseases.

CSIRO crop scientist Dr Scott Chapman's research is particularly focused on genetic and environmental effects on the growth of field crops, but he says it's exciting to apply information from a range of fields.

"Our job is to understand how crops work. And understanding how crops work helps feed the world. It's an ancient science and it's the basis for civilisation," Dr Chapman says.

"But the really fun part of agriculture is that we take ideas from other fields and work out how to turn it into food and fibre production. We appropriate ideas from everywhere and work out new ways to apply it."

As a recipient of a Priming Grant, Dr Chapman found new ways to apply unmanned aerial vehicles (UAVs) and sensors to agricultural research.

He developed this research in collaboration with Hi-Phen – a French start-up that aims to bring digital services to farmers and companies in agriculture – and they exchanged imagery datasets to test ideas shared in the visit.

"What we've developed isn't a straight-to-market solution, it's the backbone of the next step and provides breeders and agronomists the ability to deliver new varieties and management to growers," Dr Chapman says.

Dr Chapman and his colleagues are flying UAVs over crop fields to capture small plots for research. Unlike using satellites for a similar purpose, UAVs can image the crops with a spatial resolution of less than five millimetres.

They combine this data from the UAVs with data from wireless field sensors, which Dr Chapman describes as small weather stations – posts with cameras scattered among the field, allowing the researchers to watch the crops grow and to measure highly detailed temporal scans.

This means they can better prepare for oncoming challenges like climate change by breeding new varieties of crops for better tolerance to heat and drought stress.

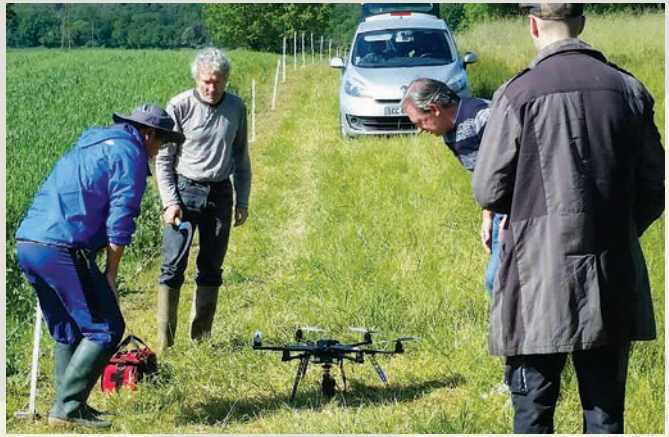
"A big part of this is trying to develop research strategy to combine high temporal sampling from these new sensors with high spatial sampling from the UAV system," Dr Chapman says.

"The UAV can fly the whole trial and do it very accurately, but only at a snapshot, so you'll only get whatever the conditions were during the flight."

Now, Dr Chapman and his colleagues have received internal funding from CSIRO to continue the research, and he says the Priming Grant helped encourage the investment.

Based in St Lucia, Queensland Dr Chapman has been a crop scientist for 25 years, worked with CSIRO for 21 years, and has been researching the value of UAVs for ten years.

"We had to build our own flying robots ten years ago, now you can just buy one online," he says.



Food and Agriculture

PARTNER ECONOMY: **NEW ZEALAND**
ORGANISATION: **THE AUSTRALIAN NATIONAL UNIVERSITY**

INNOVATION STORY

2016 PRIMING GRANTS

DR PETER SOLOMON

Weeds might be frustrating when they grow in your garden, but when they infiltrate a farm, crop yields are jeopardised.

And as one of the biggest threats to crop production, weeds are evolving shields against herbicides, and crops are losing the battle. Not only does this pose a threat to the agricultural economy, but also weakens food security.

Australian National University's Dr Peter Solomon, whose expertise is in wheat biosecurity, has discovered a way to curb the spread of weeds in crop fields, a project pursued as part of the Priming Grant.

While his research is normally focused on understanding how pathogens infect wheat, he says in this case he tried infecting weeds, making them weaker and more vulnerable to herbicides.

"In our pathogen work we made a very serendipitous finding, we found a chemical that made a disease much worse," he says.

"Like pathogens, weeds have evolved resistance to some herbicides. So those we used to apply aren't always that effective anymore."

So why doesn't the pathogen used to infect the weeds also kill the surrounding wheat?

"That's the beauty of this system, the pathogen that we used to infect the weeds is specific for weeds, not for agricultural crops. It's a very targeted approach," Dr Solomon says.

Dr Solomon engaged with an SME in New Zealand to boost the commercial value of this new technique.

He says while it was only partially successful, it was promising enough for the SME partner to keep funding and provide an ARC linkage grant.

"The market for controlling weeds is astronomically large. They're a massive, massive problem," Dr Solomon says.

Dr Solomon has been working in academia for around 18 years.

He says he was drawn to this scientific field because he was interested in the interplay between pathogens and plant hosts.

"That was my initial interest, and then once I got into it I discovered it's actually really important, not only in terms of current yield losses, but biosecurity is a big thing.

"And Australia is blessed with its isolation in terms of biosecurity."

Ten years ago, Dr Solomon was involved in an important study that found when a pathogen produces a certain protein, varieties of wheat become susceptible to disease.

His research team sent the protein to breeders, relaying the message to ensure they tested their varieties against the protein.

"It made a big difference in reducing the amount of disease to this certain pathogen. It resulted in millions of dollars in savings to the Australian wheat industry," Dr Solomon says, adding that two of the diseases were ranked in the top three in terms of their economic impact.

Food and Agriculture

PARTNER ECONOMY: **CHINA**
ORGANISATION: **GONDWANA GENOMICS PTY LTD**

INNOVATION STORY

2016 PRIMING GRANTS

MR ROBERT SOUTHERTON

Breeding eucalyptus trees is a job that requires patience - they can take up to twenty years to grow, depending on where they're located.

While this is a relatively short period compared with other types of dominating trees, paper is often derived from eucalypts and many companies can't afford to wait until a tree reaches a suitable height before they're turned into fresh paper.

This is where Gondwana Genomics comes in.

The company develops DNA tests for certain markers to boost the rate of selectively breeding eucalypt trees.

Gondwana Genomics Managing Director Robert Southerton says unlike crops such as wheat, which have been selectively bred for thousands of years to the high-yielding breed we're familiar with, humans have only just begun to try to streamline eucalypts.

"They're still pretty close to wild. There's a lot of improvement that can be made from breeding them," Mr Southerton says.

"If we're going to reduce the stress of deforestation, then we need to make the land we've got as efficient as possible."

By taking a sliver of a eucalypt – whether from bark or a leaf stem – Gondwana Genomics tests the DNA of the whole tree in a laboratory in Canberra, and peers into the seedling's future performance.

"Rather than planting trees out many, many times and replicating trials, and wait years before making selections, you can do a simple DNA test and work out a tree's performance," Mr Southern says.

"You can fast-track the breeding and get to the next generation."

So, what makes a tree "genetically superior"?

Mr Southerton says Gondwana Genomics primarily aims for high growth, stabilised tree density and a high pulp output.

"That's in general terms, but we tailor it for the companies we're working with."

Gondwana Genomics was a recipient of a Priming Grant and used the funding to build a relationship with the China Eucalypt Research Centre (CERC) and prove the effectiveness of their technology.

CERC, in turn, has a network of commercial pulp and paper companies in Southern China.

The technology, Mr Southerton explains, involves a DNA marker panel, which was sourced from CSIRO and developed in Gondwana Genomics.

This cost-effective panels lets the scientists predict the performance of future tree generations for selecting superior trees while they are still seedlings, not just within a generation.

And this predictive power from the DNA marker panels is cutting-edge.

"You get off on being the first in the world, and this technology will have a really significant impact," Mr Southerton says.

Food and Agriculture

PARTNER ECONOMY: **AUSTRIA**
ORGANISATION: **MONASH UNIVERSITY**

INNOVATION STORY

2016 PRIMING GRANTS

DR CHRISTOPH RÜDIGER

Dr Christoph Rüdiger has a perspective of the Earth not many of us get to see. The Monash University scientist has a birds-eye view of our planet and keeps watch over its face to monitor surface dynamics using satellite data.

With this data, he can observe the effects of weather events or surface changes – for instance on soil moisture and crop health.

But Dr Rüdiger says he hopes people understand that "predictions" don't have absolute certainty attached.

"There are always a range of possible outcomes, and people can be disappointed because, for example, the fire didn't start exactly there, on that date, on that hour, but two days later and not exactly in the predicted location," Dr Rüdiger says.

The uncertainty involved in his work, however, isn't necessarily a blight on the industry. "It's a challenge and that's what science is about," he says.

"If we didn't have the uncertainty, we wouldn't have science and for me it wouldn't be interesting. That's basically why I became a scientist."

Currently, Dr Rüdiger is using satellite data made available from European satellites to eye Australian farms, thanks in part to the Priming Grant.

He says the data from this new fleet of satellites, called Copernicus, can potentially change the face of agribusiness. For these kinds of satellites, the temporal resolution is unprecedented, passing over the same spot on Earth every five days.

The current satellites providing that type of data have a temporal resolution of four to eight weeks, so when it's cloudy scientists could be forced to wait months to see the surface. Now, scientists can monitor vegetation on a weekly basis.

"In Australia farmers can have tens of thousands of hectares of land, so it's crucial they don't have to drive so far through the field and still not see what's in the centre," Dr Rüdiger says.

Part of Dr Rüdiger's job is to translate data into useable visuals for farmers.

Born in Germany, the 42-year-old scientist has lived in five different countries – Germany, France, Australia, the US and the UK – and worked at organisations such as NASA and the French meteorological service.

Through this international experience and network of professional relationships, he orchestrated the data's availability in Australia, and its processing overseas.

"All the raw satellite data being free is a massive leap forward."

Working at NASA was a dream come true, he says. "When I was standing in front of the gates in the morning and getting a badge, professionally, that was my dream."

But his greatest achievement, he says, isn't strictly related to his scientific career – Dr Rüdiger trekked to Mount Everest lower base camp after a conference in the capital of Tibet.

"It was the most amazing thing to come over the last pass and suddenly see the mountain range," he says.

Food and Agriculture

PARTNER ECONOMY: **SPAIN**
ORGANISATION: **RMIT UNIVERSITY**

INNOVATION STORY

2016 PRIMING GRANTS

DR JORGE PAZ-FERREIRO

For some scientists, their career will take them as far as the lab, and if they're lucky, to conferences in exotic places.

As an environmental engineer focused on making soil more sustainable, Dr Jorge Paz-Ferreiro's work led him to sunny Spanish vineyards, thanks to the Priming Grant.

The RMIT-based scientist partnered with two small and medium-sized enterprises to improve wine-makers' waste management and soil quality.

"They have some common problems, but some were a bit more specific, so it was challenging to work out a good solution for all of them," Dr Paz-Ferreiro says.

The solution Dr Paz-Ferreiro offered was to use charcoal as a 'soil conditioner'.

Charcoal changes the physical properties of soil, such as its nutrient content, but Dr Paz-Ferreiro used it primarily to reduce the soil's acidity.

He says putting waste material preceding charcoal into soil is a sustainable approach as it sidesteps the production of greenhouse gases. Charcoal either ends up buried in landfills where an absence of oxygen causes it to release methane, or it's burned and carbon dioxide is flung into the atmosphere.

"They are all interested in collaborating and putting a project together on finding a sustainable way to manage vineyards with charcoal," Dr Paz-Ferreiro says.

"In this case we're transforming it into a product that can be reused in the soil."

Dr Paz-Ferreiro says the experience was gratifying, and he and the winemakers learned from one another.

In one case, the winemakers in an area with a relatively drier climate preferred to use the charcoal to create a kind of mulch.

"They came up with another strategy that would be more convenient for them. In fact, it was more interesting to try both incorporating it into the soil and applying it on the surface as a mulching material," he says.

For Dr Paz-Ferreiro, Spanish vineyards are a site of nostalgia. The 37-year-old environmental engineer was born in the northwest of Spain, and his grandfather owned a vineyard.

"I got to know a lot of people through this grant and they were not so far from my home town," he says.

He moved to Australia in 2014 and has been kept busy by both his research and lecturing.

"I try to inspire students to love the environment," he says.

"Australia has provided me with very good opportunities. Here I have created my research group, I have a continuing position, I can apply for grants and I'm always interested."

Food and Agriculture

PARTNER ECONOMY: **UNITED STATES OF AMERICA**
ORGANISATION: **UNIVERSITY OF TASMANIA**

INNOVATION STORY

2016 PRIMING GRANTS

PROFESSOR ROGER STANLEY

What do submariners eat once they've submerged? University of Tasmania's Professor Roger Stanley is making sure Defence personnel stationed in remote locations don't go hungry by creating food that not only has a long shelf-life, but also is high in taste and nutrient content.

Professor Stanley is the Foundation Director of the Centre for Food Innovation, an appointment that is partly funded by the Australian Defence Science and Technology Group which has a major research laboratory in Tasmania.

In this role, he helps come up with innovative solutions for personnel who can't access fresh food, when, for instance, they're stationed somewhere remote.

"In Defence, you have people out in the field who have to live on processed food, with none of the fresh fruit and vegetables they normally have. It can become very repetitive and unappetising," he says.

There are two main processed food requirements used by the Department of Defence: ration-packed food, which must last for at least two years and remain stable under extreme conditions; and the ability to mass feed.

"It's the dual purpose of defence outcomes and the industry need to be able to send added value food to more distant markets, by targeting the customers who are prepared to pay for quality," Professor Stanley says.

This "dual purpose" of targeting both defence and industry is what the Priming Grant project aimed to fulfil.

The Priming Grant allowed Professor Stanley to develop collaboration with a US microwave food technology company called 915 Laboratories and connect with their researchers and the technology inventors at Washington State University.

Through 915 Laboratories he has accessed technology that the USA have been developing since 2001 that uses microwaves to sterilise food for troops overseas.

"The theory and technology approach have been known for a long time, but getting a practical system that can meet the regulatory requirements of guaranteeing sterility has been a challenge," Professor Stanley says.

One of the challenges is that the food must be contained in plastic to be microwave processed, and since plastic lets in oxygen that can damage long stored foods, the barrier properties had to be improved.

"Our role has been to work with the US lead on this and to bring it into Australia for adaptation to Australian industry," he says.

"Food processing has to meet the same gold standard of safety worldwide. Getting the agreement to work with them in the future is a sensible way to ensure that an Australian product continues to be recognised for quality and safety."

More broadly, Professor Stanley's research has two parts: sustainable food production and foods that address lifestyle diseases. Food for health, he says, is the aspect of research he's most passionate about.

"We still do food and health because defence still needs to understand how food can be used to deliver health and performance outcomes as well as nutritional outcomes."

Food and Agriculture

PARTNER ECONOMY: **IRELAND**
ORGANISATION: **LOWES TC PTY LTD**

INNOVATION STORY

2016 PRIMING GRANTS

MR GREG LOWE

Once plant breeders create a unique variety of plant, strengthening desirable traits like disease resistance, how do they make it accessible to thousands of people?

One solution is to clone it under sterile conditions with access to all the nutrients it needs, a method called tissue culture. This shields the plant from diseases or pests.

Tissue culture is what the Australian company Lowes TC is founded on. Lowes TC director Greg Lowe says cloning with tissue culture keeps plants in high health, more so than if they were propagated outside in a greenhouse.

"The plant breeder comes up with the 'you beaut' variety that has three per cent more sugar content in the sugar cane, or the blueberries are bigger, for example," Mr Lowe says.

"Once he has one plant like that, he of course wants thousands. That's what we do, and we can keep the plant in perfect health."

This also means the plants can more easily be shipped across international borders, as tissue culture has a reputation for being disease-free.

"Inside the lab it's eternally spring. The plants basically want to grow all the time – we can produce a crop of petunias in the middle of winter."

Mr Lowe was a successful recipient of a Priming Grant and his goal was to use the funds to bring Yacon to Australia. Yacon is a sweet plant traditionally grown in South America.

He met with a researcher from the University of Dublin in Ireland; however, he says bringing Yacon to Australian shores was ultimately unsuccessful.

But in a fortuitous turn of events, their meeting created an opportunity to network with another researcher from the University of York who was cultivating precious wasabi plants.

Wasabi paste we eat with our sushi in Australia is, in many cases, predominately horse radish.

"True wasabi tastes just fantastic and totally different. There are vast shortages of the crop in the Japan, nobody can get enough of it," Mr Lowe says.

Wasabi traditionally grows in cool, shady conditions. After selecting and propagating a clone to grow along a portion of the NSW coast, Mr Lowe says he and his colleagues at Lowes TC managed to keep a variety of wasabi thriving throughout a Sydney heatwave.

The University of York researchers' goal is to extract the active ingredient of plants, and then commercialise it. Since true wasabi comes from the stem, the leaves get wasted, despite having the active ingredient.

'We feel that there's a lot of by-product from the wasabi, and working with the University of York bio-renewables, we can figure out a way of using the by-product to produce wasabi paste that's real wasabi," Mr Lowe says.

Food and Agriculture

PARTNER ECONOMY: **GERMANY**
ORGANISATION: **NATIONAL CENTRE FOR ENGINEERING IN AGRICULTURE**

INNOVATION STORY

2016 PRIMING GRANTS

DR BERNADETTE McCABE

Associate Professor Bernadette McCabe's research provides an elegant solution to a not so glamorous topic. As principal scientist for the National Centre of Engineering and Agriculture at the University of Southern Queensland, her primary research focus is on waste recovery and energy capture.

This means she breaks down organic waste by starving microbes of oxygen, triggering a natural process that creates biogas – a sustainable combustible fuel alternative that can provide electricity, heat or both. The leftover product, "sludge", can be used as a nutrient-rich bio fertiliser.

Her expertise creates a win-win situation by generating energy using biogas technology and is critically important to make our waste-heavy culture more sustainable.

"It's going to help Australia meet its renewable energy targets and decarbonisation efforts," Dr McCabe says.

Dr McCabe represents Australia for the International Energy Agency Bioenergy program Task 37: Energy from Biogas, giving her a unique perspective in understanding where Australia sits compared to the rest of the world. Australia's bioenergy sectors only accounts for 1.5 per cent of total electricity generation.

Compared to countries like Finland, Sweden and Denmark, whose bioenergy use sits at around 20 per cent, Australia lags behind the rest of the world, Dr McCabe says.

"We're riding a wave of bioenergy and we're only still really at embryonic stages. Given that biogas and bioenergy is an emerging industry, the only way is up from here and I find that really exciting."

Dr McCabe's passion for waste recovery spans both her workplace and home.

The Sydney-born scientist lives rurally in Toowoomba on 40 acres of land, which she shares with a pig, chickens, horses and dogs.

All the scraps of food that don't get eaten are scattered for her chooks and pigs.

"Essentially what ends up in our wheelie bin is one shopping bag full every week," she says.

"And I've been saying to my husband that our recycling bin needs to be collected more frequently."

Before Dr McCabe began researching fulltime, she was an academic feeding her other passion – education. In 2011, she taught bioscience courses to nursing and science students. For her efforts, she won an Australian Learning Teaching Council citation award.

"About 60 per cent of nursing students at USQ were mature aged and had little confidence in their ability to study science," she says.

"That was a challenge, but an interesting one at that."

Dr McCabe was a successful recipient of the Priming Grant, which was used to form a partnership with Ultrawaves GmBH CEO Dr Klaus Nickel to transfer German expertise in ultrasound technology to Australia's wastewater treatment plants.

High-powered ultrasound would boost the efficiency of generating biogas by increasing the amount of methane gas that can be captured and used.

GLOBAL CONNECTIONS FUND

The Global Connections Fund (GCF) is a component of the Global Innovation Strategy under the Australian Government's National Innovation and Science Agenda. The GCS enables Australian SMEs to link with international researchers and Australian researchers to collaborate with international SMEs to seize opportunities in priority areas of importance to the strategic growth sectors of Australia.

The GCF is comprised of two types of grants: Priming Grants and Bridging Grants. Priming Grants are small grants of $7,000 to enable Australian SMEs and Australian researchers to physically meet with their international partners and develop their collaborative ideas. Bridging Grants are larger grants (up to $50,000) designed as seed funding capital to enable viable projects to grow in scope and scale, to test commercialisation and proof of concept activities.

www.globalconnectionsfund.org.au

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NATIONAL INNOVATION & SCIENCE AGENDA

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