agresearch

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intouch

New Zealand Agricultural Greenhouse Gas Centre Director Dr Harry Clark (left) with Prime Minister John Key outside the Centre at the official opening.

New Zealand Agricultural Greenhouse Gas Research Centre opened

A Government-funded Centre for agricultural greenhouse gas mitigation research, opened earlier this month by Prime Minister John Key, aims to increase agriculture's ability to create wealth for New Zealand in a carbon constrained world.

Backed by Government funding of $5 million a year over the next 10 years, the New Zealand Agricultural Greenhouse Gas Research Centre is a partnership between AgResearch, DairyNZ, Landcare Research, Lincoln University, Massey University, NIWA, Plant & Food Research, the Pastoral Greenhouse Gas Research Consortium (PGgRc) and Scion. Its office is based at AgResearch Grasslands.

Centre Director Dr Harry Clark says the Centre brings together key New Zealand scientists to work on one of the biggest challenges of our time.

"The Centre will lead and co-ordinate research to reduce methane and nitrous oxide emissions, and to increase the rates of soil carbon accumulation. This research will underpin the development of novel, credible and cost-effective low greenhouse gas (GHG) emitting production systems that provide farmers with practical options for reducing emissions," he said.

"While agriculture creates about half of New Zealand's GHG emissions, it also generates around 44 per cent of New Zealand's merchandise export earnings and so is a critical contributor to New Zealand's livelihood. The challenge is to find ways for New Zealand to meet its international GHG emission obligations without reducing agricultural output."

The Centre will also play a key role in New Zealand's science input into a world-wide initiative, the Global Research Alliance (GRA), announced in Copenhagen last year.

Details of the projects supported and co-ordinated by the Centre will be announced in May. This issue of intouch highlights a small sample of current research into lowering New Zealand's agricultural GHG emissions.

For more information contact harry.clark@agresearch.co.nz or visit www.nzaggrc.org.nz

In pursuit of plants that reduce methane production

The hunt is on for plants that show potential for suppressing methane production in the rumen of our farm animals.

An AgResearch team led by Dr Gerald Cosgrove is screening a broad range of forage and non-forage plants to determine whether there are plant species or plant traits that can reduce agricultural methane emissions.

In a three-year project funded by MAF through the Sustainable Land Management and Climate Change Fund, Gerald and the team are not only looking at forages typically used in New Zealand, but casting the net as widely as possible to discover whether other plants have the potential to mitigate emissions.

Tannin-containing plants is one group they're looking into. Tannin in plants has been shown to affect digestive processes in the rumen, and may possibly result in lower methane production. Plants containing oil are also under investigation, as plant oils are thought to suppress the microbes in the rumen that produce methane.

In exploring the role of indigenous plants in reducing methane in the rumen, the team is working with Rangitaane o Manawatu (the mana whenua iwi in the Manawatu), drawing on their knowledge of medicinal plants, and in particular, plants with specific properties matching those of the wider project.

"Our iwi partners have knowledge about indigenous plant preparations and traditional uses in restoring gut function, those that have antibacterial and antimicrobial properties, as well as plants containing tannin and oils. It is hoped that this knowledge will benefit our project looking at reducing agricultural methane production by ruminants," Gerald says.

Dr Gerald Cosgrove (left), and his team including Dr Mike Tavendale (middle) and Michelle Kirk (right) are on a mission to find plants that could suppress methane production in our farm animals.

So Gerald and his team will now screen this myriad of plant species for their impact on methane production in the rumen. They'll firstly simulate the digestion process in a 24-hour laboratory test using rumen fluid and the plant material and measure the gas produced. Plants that show promise from this test will undergo a two-week lab test that more closely simulates the rumen environment to see if the "knock down" effect can be sustained over a longer period of time . Plants that show encouraging results through these two steps will go on to animal testing.

If they're successful in narrowing down plants that work to reduce methane produced in the rumen, the next step would be to explore the most practical way to deliver the benefit to animals. This could mean selectively breeding forages for low emission properties, or, if a specific bioactive in the plant is identified, this could perhaps be extracted from the plant to be fed as a supplement.

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Genetics may be key to breeding low methane sheep

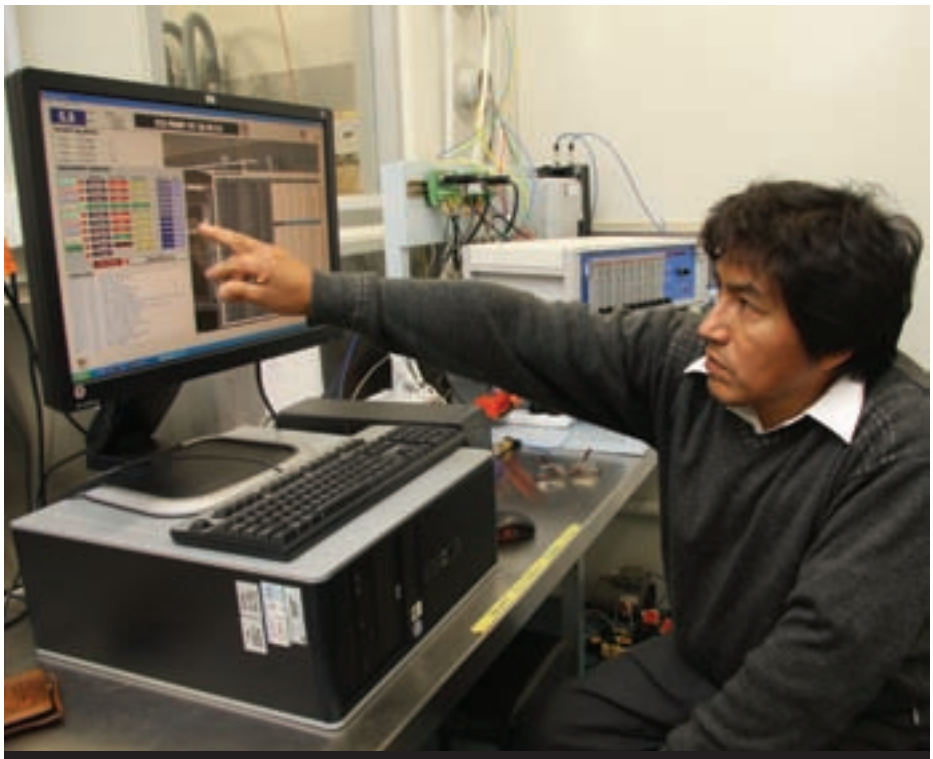
Scientists are delving further to see if the discovery of sheep that produce less methane could lead to breeding farm animals with lower greenhouse gas emissions.

Working on projects funded by the Pastoral Greenhouse Gas Research Consortium (PGgRc), AgResearch scientists last year made the world-leading discovery that a low-methane flock produced consistently lower emissions, even when tested on a variety of feeds.

AgResearch scientists John McEwan and Dr Cesar Pinares are now joining forces in a three-year PGgRc/Sustainable Land Management and Climate Change (SLMCC) project to ascertain if the low-methane sheep pass their emissions profile on to their offspring, and to determine that they are also efficient producers. Any breeding programme would need to cut methane without compromising production.

PGgRc Manager Mark Aspin says the expansion of this programme is a logical step that arises from the promising leads found initially through screening 700 dairy cattle, and then confirmed in the last 18 moths with the work on sheep. This project is part of a wider programme under the PGgRc that is also investigating phenotypic markers and candidate genes in cattle.

Cesar is testing progeny of sires from the low methane flock to measure the amount of methane emitted per unit of feed eaten, while John is providing genetic and genomic skills to understand how genetically variable the low-methane trait is, and how it is related to other traits, such as productivity. The PGgRc/SLMCC project is also a collaboration with Ovita, and Meat & Wool New Zealand, who provide research animals.



Dr Cesar Pinares is measuring methane emissions from sheep to see whether genetics could be behind breeding sheep with reduced greenhouse gas emissions.

Repeatedly measuring the animal's methane emissions in a respiration chamber is laborious, and expensive, so the project also aims to come up with a faster, cheaper way to obtain emission estimates and facilitate breeding programmes. Options include genomic selection using a SNP chip (a cutting-edge technology that enables the scanning of up to 50,000 genetic variants at once) or seeing whether blood or saliva testing can be used to find low-emission animals.

John says results from the first pilot project point towards the low-methane trait being genetically variable - and it's hoped that exploring the genetics behind these low-methane sheep will eventually result in breeding programmes for low-emission sheep, cows, goats and deer.

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PGgRc®
PASTORAL GREENHOUSE GAS
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The official opening of the New Zealand Agricultural Greenhouse Gas Research Centre

Developing profitable, low emission farming systems

Any measures to reduce the carbon footprint of our farms must take into account the whole farming system, and its profitability – a complex balance that an AgResearch and DairyNZ group is hoping to unravel.

AgResearch's Dr Robyn Dynes (left) and Dave Clark, Principal Scientist from DairyNZ, are part of a group looking to develop profitable farm systems, with lower emissions.

In a three-year collaborative project, led by AgResearch Senior Scientist Dr Robyn Dynes, the group aims to create profitable farming systems which reduce the carbon footprint of New Zealand farms. They plan to do this by building knowledge on how farm management decisions impact the carbon footprint and the economic performance of pastoral farms.

Funded by the MAF Sustainable Land Management and Climate Change Fund, the team will link life cycle analysis (the evaluation of systems and practices to give a full picture of resource use, and where emissions occur) with systems and component models to better assess the effectiveness of greenhouse gas (GHG) mitigations. They also want to ensure that mitigation measures result in whole-system improvements.

"A farm's total GHG emissions is not just due to the sheep, or the soil's nitrous oxide, it's actually the whole system, and how the components interact," Robyn says, "So if we don't represent those in building our understanding, then there is the potential for unintended consequences, and that might be increasing overall total emissions, or reduced water quality or animal welfare – so a systems analysis is essential."

This knowledge will then be used to develop a framework of modelling tools for assessing farm or industry level impacts of GHG mitigations, and identify the key features of GHG and carbon-friendly farming systems that are profitable.

"Farm management decisions within the system are going to be the major opportunity that our farmers have to reduce their carbon footprints, so we want to be able to give them the tools for them to make informed decisions, and also to help policy makers understand the implications of regulation and policy."

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Knocking out methane with clever design

Reducing agricultural greenhouse emissions may be a case of good design – with scientists on a mission to design inhibitors that shut down methanogens that produce methane in grazing animals.

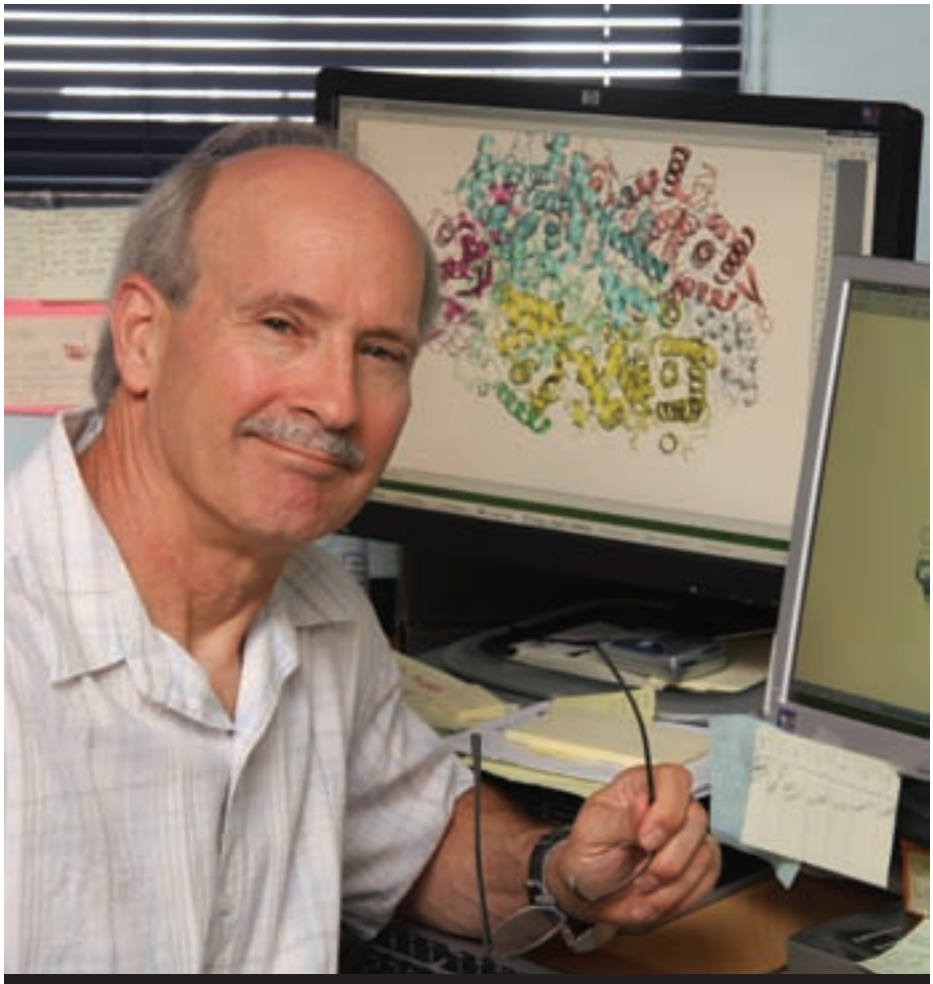
Working on projects funded by the Pastoral Greenhouse Gas Research Consortium (PGgRc), AgResearch Scientists Dr Graeme Attwood and Dr Ron Ronimus are looking to reduce methane production by designing molecules that inhibit enzyme reactions essential to methanogen function.

Graeme, Ron and their teams firstly needed to identify features that are essential for methanogens to function, and features that are shared by all methanogens. The successful sequencing of the methanogen genome by AgResearch scientists working on PGgRc funded projects in 2008 has allowed them to identify these common features.

The trick in designing methanogen inhibitors is to make them targeted to only knock out the methanogens – not the organisms within the rumen which digest feed and supply nutrients for the animal. Focusing on features that are shared by methanogens and not closely related to other organisms is therefore the key.

They go about this by comparing genetic sequences and examining metabolic pathways to identify genes found in methanogens only. Once they've identified those sets of genes, then they look at the proteins encoded within these genes – specifically, their three-dimensional structure. They're looking for the catalytic site - the engine room of the enzyme where the reaction actually takes place.

Having identified this site and how it's structured, they can then go about designing a compound to inhibit this reaction.



Dr Ron Ronimus is looking into using three-dimensional structures of proteins as part of a chemogenomics programme for designing methanogen inhibitors to trim agricultural greenhouse gas emissions.

Enzymes can be described as a lock with a key, where the enzyme is the lock, and the key is the substrate that fits precisely into that lock. The process to identify inhibitors is about trying to find another key that will fit the lock at that catalytic site, and prevent the enzyme from working.

So it's a complex design process, in its early days, but Graeme and Ron have made some solid strides towards cracking it, and closing in on the day when these methane inhibitory compounds will be delivered to our ruminant animals, and help reduce agricultural greenhouse gas emissions.

For more information contact graeme.attwood@agresearch.co.nz or ron.ronimus@agresearch.co.nz

Distinguished Biotechnologist of Year

AgResearch's John McEwan got a major award when New Zealand's leading bioscientists were celebrated on 23 March at the 6th annual NZBIO Conference Awards.

With over 30 years of research and achievement, John received the 2010 Ross Clark Distinguished Biotechnologist of the Year Award, supported by PALL Life Sciences. This award is presented to a leader in their field whose utilisation of biotechnology during their career has contributed significantly to improving quality of life.

John has been a leader in genetics research assisting the sheep and cattle industries - including developing a national sheep recording database, five DNA tests to identify sheep carrying specific traits such as increased loin muscling and most recently the use of the Sheep DNA sequence to further drive the genetic improvement of our national flock.

The judging committee noted "John McEwan has used modern genomics to develop commercial tests for identifying valuable traits in sheep which are otherwise difficult to detect. It is applied research which is having a significant financial impact on sheep farming in New Zealand and helping to maintain the industries competitive position."

John acknowledged his colleagues "I am very happy to accept this award, I feel it represents recognition of what the AgResearch Animal Genomics group has delivered to the sheep, cattle and deer industries over the past two decades."

"It demonstrates how we are now able to translate basic international science efforts like sequencing of the cattle, sheep and deer genomes into useful industry applications. This may appear to be a tough sell, but over many years I have been very strongly supported by industry organisations and especially performance recording breeders in this role and am very humbled by their support."

AgResearch's John McEwan (left) was presented with his award by Hon Dr Wayne Mapp, Minister of Research, Science and Technology.

Three hundred New Zealand and international guests attended the NZBIO 2010 Awards Dinner. Sponsored by AgResearch, the dinner featured a live cooking demonstration by Senior Meat Scientist Dr Mustafa Farouk, who took to the stage to reveal his 'secret recipe of a thousand years'.

Young Dairy Scientist Award

AgResearch's Kirsty Hammond won the Young Dairy Scientist Communication Award in March at the Large Herds Association Conference held in Southland.

Kirsty, an AGMARDT scholar, is studying with Massey University and AgResearch for her PhD. Her work, as part of the AgResearch Climate, Land and Environment team, is on how the chemical composition of different pasture feed influences the methane emissions of sheep and cattle. This work has already earned her a range of other awards.

The Young Dairy Scientist Communication Award was judged over 3 areas, a 5-minute powerpoint presentation, a poster session and an industry article.

According to the chairperson of the Conference session, Massey's Peter Hutton, Kirsty won for two main reasons; firstly, she was able to successfully convert and communicate some complicated science into popular media formats which are easily understood by the farming, scientific and general community; and secondly, her enthusiasm for her subject won the hearts and minds of the conference delegates who formed a large part of the judging contingent. The conference delagates voted on the 5-minute talk and the poster session. Five industry professionals judged the industry article.

Kirsty Hammond.

Kirsty finished in 1st place for the 5-minute talk and the poster session and 2nd place for the industry article.

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