DEEResearch

RESEARCH PROGRAMME

2013-14

CHAIRMAN'S INTRODUCTION

It is with great pleasure to present on behalf of the DEEResearch Board the research programme for the current DEEResearch year.

The make-up of the programme is the result of a great deal of deliberation that took place to align DEEResearch's research objectives with the needs of the wider deer industry. We were keen to embark on a programme that could contribute towards the deer industry's profitability targets, as worked out in the Productivity Improvement Programme in which many of our stakeholders were involved. Those targets are now the focus of the Passion2Profit programme. In coming up with the portfolio of projects, we consulted closely with Deer Industry New Zealand and the Productivity Leadership Group and worked hard to satisfy ourselves that our own research objectives and the projects to meet them really were aligned with the deer industry's needs and could genuinely contribute towards attainment of Passion2Profit targets.

We have also taken note of regulatory developments that demand compliance by producers with environmental limits. Our research will examine the impact of deer on the environment and assist deer farmers in mitigating their impacts.
This year is also the first year of a new five year relationship with AgResearch through the Hitting Targets for Deer Industry Profitability project (HITDIP). In investing in this new five year project, DEEResearch considers that there is significant value to the deer industry from both sides demonstrating long-term commitment to understanding more about the animals we produce and how we can produce and process them more profitably and sustainably. This brochure sets out the details of the sub-projects under HITDIP that will feature at least in its first year. Some of them will last for the duration of the project whilst others are shorter and sharper.

This brochure also contains details of other research in which DEEResearch invests, whether with other pastoral sector bodies through the research consortia or through shorter, deer-specific studies.

We are confident that the overall portfolio covers exciting bases that must be understood and will provide the platform for advancing deer industry productivity on the scale achieved by other sectors.

Much of DEEResearch's work is reliant on collaboration with commercial deer farmers and processors, who supply information through surveying, allow the use of their herds, premises or equipment, or provide valuable feedback on technologies or practice change recommendations arising from research. On behalf of the Board, I wish to acknowledge the generosity of time and resource of our industry partners and commend the industry-good spirit that will continue to drive industry development.

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CONTENTS

STRATEGIC INVESTMENTS

DEEResearch invests in or commissions medium-to-long term science projects where the objectives are broad in scope and the outputs can potentially be applied in a variety of ways. These projects typically last at least three years and involve multiple researchers and facilities.

RESEARCH PARTNERSHIPS

DEEResearch makes investments into projects that are not deer-specific (although they may incorporate deer-specific elements) in accordance with a DEEResearch policy on pan-sector investments, the main points of which are that-

- the aims of the research partly or fully meet a DEEResearch research objective;
- the deer industry would not otherwise be granted access to the research outputs or industry access would likely be more costly than the cost of investment;
- the investment sought is less than would be required to achieve the same output were DEEResearch to solely commission the project or be the sole partner with the Crown;
- DEEResearch has a share in any intellectual property arising commensurate with its investment; and
- outputs will be made available on reasonable terms for further development by DEEResearch and/or delivery, if development or delivery will not be made by the pan-sector group.

There are three research partnerships (formerly called 'Consortia') in which DEEResearch is a member. They are Johne's Disease Research Consortium, Pastoral Genomics Research Consortium and Pastoral Greenhouse Gas Research Consortium. Each of them also has the Crown as an investor (the Crown contribution matching the entirety of the industry investment), as Crown recognition that collective commitment by industry to tackle common issues will produce faster and better outcomes and impacts for New Zealand – and of course make more efficient use of New Zealand's research capability.

DEEResearch sees benefits in investing in pan-sector research since for many issues, the fundamentals are the same for different ruminant species. Specific deer research can be commissioned later if required.

PASTORAL GENOMICS RESEARCH CONSORTIUM

Pastoral Genomics Research Consortium (PGRC) aligns investment by all New Zealand pastoral industries into forage improvement through biotechnology to deliver on-farm benefits to their farmers.

What is already known in the area?

Biotechnologies – such as marker-aided breeding and cisgenics – offer the greatest likelihood of stepwise and sustainable improvements in plant productivity. This is being demonstrated in crop species around the world but is yet to be applied in pasture species such as ryegrass and clover that are the foundation of New Zealand's pastoral industries that underpin most of the country's export wealth.

Research spectrum

H2 (applied)

Hypotheses or research questions addressed

NZ pasture species can be improved with technologies that augment and enhance breeding methods used to date. PGRC is using its in-depth knowledge of pasture genomes to enhance conventional breeding. It aims to use ryegrass genes in ryegrass, clover genes in clover to capture the untapped genetic potential in pasture plants.

Project design

DNA signatures are identified that indicate in which plants a breeder will find valuable traits such as palatability, productivity, and persistence.

After proving the statistical link between the signature and the trait, PGRC confirms that this works in a typical forage breeding setup and then equips commercial breeders with the knowledge and a simple test that allows them to use it in their own well-established breeding system.

Addtionally, PGRC tests individual forage genes that provide large gains in individual traits when re-introduced into the forage. These tests are carried out in containment greenhouses and ensure that farm-relevant traits are targeted. The best-performing plants are selected for larger trials; eventually these will be farm-level trials that confirm significant leaps in traits that will translate into farm profits.

People and facilities

The Forage Improvement team based at the AgResearch Grasslands campus in Palmerston North has world-leading expertise in white clover and ryegrass improvement through biotechnology. The Forage team at ViaLactia in Auckland has world-beating expertise in ryegrass biotechnology.

Types of output

Tools for breeders to make newer and/or faster improvements to forage productivity, persistence, palatability, and positive environmental impact (e.g. less fertilizer).

Pastoral Genomics

New forage cultivars that offer jumps in productivity, persistence, palatability, and positive environmental impact.

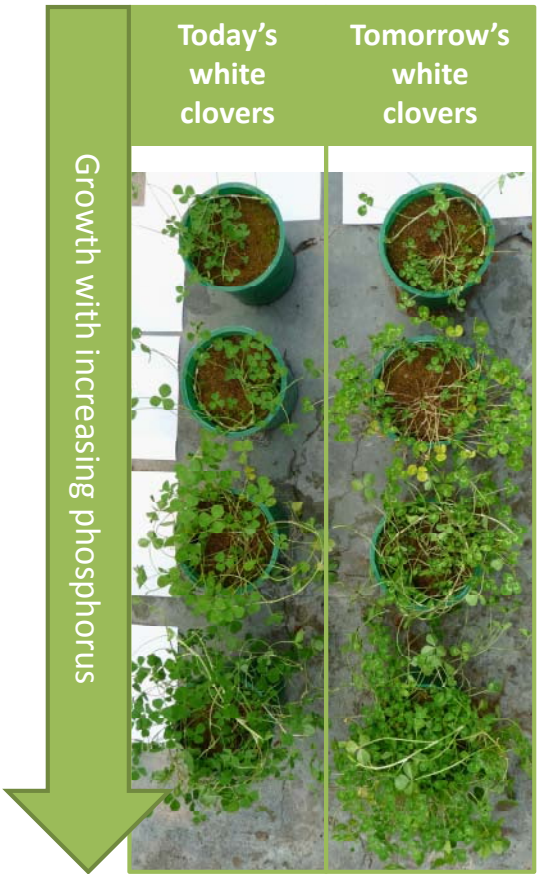
Implementation pathway for outputs

The next step is to form partnerships with the forage seed companies to integrate the biotechnology outputs (tools and plants) into their current breeding in order to deliver the benefits as soon as possible to pastoral farmers.

In addition, field trialling of the best candidates for step-changes in traits like drought tolerance and very-high-sugar grasses will be carried out.

Specific work being undertaken in 2013/14

- Proofs-of-concept for reduced nitrogen-use ryegrass and reduced phosphorus-use white clover
- Transfer of tools for marker-aided breeding of 3 traits from researchers to commercial breeders
- Development of new broad-bred clover crosses that will lead to a commercial cultivar in 3-4 years
- Further contained trials for ryegrasses with improved drought tolerance, very high sugars, and improved year-round productivity, and for white clover with improved year-round productivity
- Continue to build platforms that will accelerate forage improvement in the future e.g. capture array, metabolomics, genome sequencing



PASTORAL GREENHOUSE GAS RESEARCH CONSORTIUM

Pastoral Greenhouse Gas Research Consortium (PGgRc) is a partnership between the livestock industry and the Crown. It aligns investment by all the pastoral industries into greenhouse gas (GHG) reduction with the NZAGRC and Ministry for Primary Industries. AgResearch is also a contributing partner and PGG Wrightson and the Fertiliser Association are equity partners in the venture. The total annual budget for this investment is $5.4m and is contracted through to 2019.

What is already known in the area?

After 11 years of work, The consortium has identified that-

- low methane production is a heritable trait;
- ruminants produce antibodies against methanogens (the organisms that produce methane in the rumen), providing an opportunity to produce a vaccine against methanogens;
- methanogen enzymes work in a unique way that could be inhibited without compromising their role in fibre degradation;
- sheep grazing some forage brassicas have shown 25-30% reduction in their methane emissions; and
- reductions in methane production do not seem to be at the expense of rumen fermentation efficiency.

Research spectrum

H1-H3 (from fundamental to practice change)

New knowledge to be generated by the research

The research is focussed on means to reduce the GHG intensity of pastoral production. However, every workstream in the programme must also determine the impacts of the mitigation solution in question on productivity and food quality.

Hypotheses or research questions addressed

The unifying research aim of all projects is to deliver cost–effective direct mitigation solutions for farmers with the aim of not impacting negatively on productivity. The solutions are intended to lead to a reduction in GHG intensity (GHG/kg product) of 1.5% p.a. in the livestock industries additional to the 1% reduction achieved through increased efficiency by enhancing productivity.

People and facilities

Breed low-CH4 emitting ruminants: John McEwan, AgResearch Invermay
Identify low-GHG feeds: David Pacheco, AgResearch Grasslands
Develop a vaccine to reduce ruminant CH4 emissions: Neil Wedlock, AgResearch Grasslands and Hopkirk Institute, Palmerston North
Inhibitors that reduce ruminant CH4 emission: Ron Ronimus, AgResearch Grasslands

Types of output

Breeding values, Genomic markers, Vaccine, Inhibitory compounds, productivity impacts

Implementation pathway for outputs

Each research aim will have different products and therefore different implementation pathways.

Specific work being undertaken in 2013/14

The programme will address four research aims:

- breed low-CH4 emitting ruminants;
- identify low-GHG feeds;
- develop a vaccine to reduce ruminant CH4 emissions; and
- identify inhibitors that reduce ruminant CH4 emissions.

These are complemented and integrated through additional objectives providing underpinning science and also engagement with end users and commercial players that will be pivotal in delivery. Figure 2 shows how the programme is aligned.

JOHNE'S DISEASE RESEARCH CONSORTIUM

What is already known in the area?

Johne's Management Limited's (JML's) database of JD-suspect lesions (JDSLN) from slaughtered deer relates to on-farm experience of disease and has 7 years'-worth of data. A set of diagnostic tools is available and in common use by farmers to assess the JD status of deer herds and/or individual deer.

Research spectrum

H2-H1 (applied science and transfer)

New knowledge to be generated by the research

The aim of this study is to establish a set of best-practice diagnostic guidelines that reduce uncertainty around the use of JD diagnostic tools in the deer industry and provide case studies relating to success JD management on-farm, by building on existing knowledge and filling gaps in current understanding.

Project design

i. *Validation of the JDSLN rate against on-farm impacts of JD* A survey of 150 deer herd owners is being conducted, with herds selected to represent the range of farm-level JDSLN rates identified in processed deer. The herd owners' perspective of JD will be correlated with herd-level production losses, JDSLN rates and the economic impact of the disease.

ii. *Comparison of serum ELISA tests* The ability of two serum ELISA tests (Paralisa™ and PARACHEK®2) to detect deer shedding high levels of MAP in their faeces will be compared in cull R2 deer from herds known to be experiencing production loss due to JD. The diagnostic evaluation will include qPCR analysis and strain-typing of MAP for selected samples. The JDSLN status of all sampled deer will also be evaluated at processing.

iii. *Case studies* The impact of implementing a JD Risk Management Plan, use of diagnostic testing (Paralisa™ as the primary test), and management recommendations from the Johne's Consultant Network veterinarians will be assessed and reported for 4-6 deer farms over the 2 year study period.

Sampling and surveys will be carried out over the 2013-2014 seasons.

People and facilities

A multifaceted project team has been drawn together to complete this work. The project is being managed by Peter Fennessy and Neville Jopson of AbacusBio Limited and team members include AbacusBio staff, Solis Norton (JML) and JCN Veterinarians. Diagnostic Services are being provided by Disease Research Laboratory, AgResearch and Canterbury Health.

Types of output

Best-practice guidelines for the use of existing diagnostics under a range of different management scenarios will be generated from this study. They will be incorporated with current understanding to update best-practice guidelines for the control of JD in deer. A final report and industry workshops to disseminate learnings are planned for early 2015.

Implementation pathway for outputs

The guidelines will be published, promoted and distributed in a series of workshops, run under the direction of JML, to transfer the information directly to farmers and veterinarians.

Specific work being undertaken in 2013/14

The collection and analysis of samples began in 2013 and will continue through 2014. The project team will also be completing the farm surveys for the validation study in the 2013-14 year.

HITTING TARGETS FOR DEER INDUSTRY PRODUCTIVITY

Hitting Targets for Deer Industry Profitability (HITDIP) is DEEResearch's flagship 5 year research project. The project is carried out by AgResearch, Deer Industry New Zealand's partner in DEEResearch.

Through AgResearch, the project harnesses New Zealand's greatest pool of deer and multi-disciplinary science capability and facilities and also benefits from its willingness to draw on external resource where required. Researchers working on the programme are a mix of longstanding deer system experts (including physiologists and parasitologists), scientists who work on several systems (such as sheep and beef) and scientists from disciplines that are not species-focussed at all, such as social scientists, environmental scientists, biostatisticians, quantitative geneticists, economic modellers and the like.

Another strength of HITDIP, like its predecessor Venison Supply Systems Programme (VSSP), is the partners' approach to flexibility; DEEResearch and AgResearch recognise that by their nature, research hypotheses are not always proven in which case they are willing to shift the focus of the work to other avenues that have potential impacts for the deer industry.
HITDIP is a project that builds on outputs – and continues some sub-projects - from the VSSP. It is strongly focussed on assisting venison producers, processors and marketers to achieve the aspirational 10-year and 20-year targets for improved profitability, as outlined in the deer industry's Passion2Profit transformational change programme.

The project structure is sub-project based, sub-projects being aligned to specific DEEResearch themes which are themselves aligned to the industry targets within Passion2Profit. In this first year, the sub-projects are aligned with six of the ten DEEResearch themes. As several of the starting sub-projects have a duration shorter than HITDIP, new sub-projects will be commenced later in the project and they may address the other DEEResearch themes (Venison Attributes, Environment (Greenhouse Gases), Animal Welfare, and Food Safety) depending on the deer industry's needs at the time.

Within this project there is a balanced portfolio of research types in relation to science horizon, ranging from H3 (strategic/ fundamental) science through to H1 (adoption/practice change). All sub-projects have had to demonstrate to DEEResearch's satisfaction a clear implementation pathway to deliver impacts for the deer industry, even if intervening research is required.

THEME 1: EFFICIENT LAND USE

ACHIEVING PRODUCTIVITY TARGETS

What is already known in the area?

While productivity targets have been set by the deer industry, relatively little assessment has been done of how farm systems will need to be configured to meet those targets.

Research spectrum

H2-H1

New knowledge to be generated by the research

The requirements for the future design of farm systems will be developed.

Hypotheses or research questions addressed

What animal and feed supply systems will be needed to meet future industry productivity targets?

Project design

Impacts of targets will be modelled on current farm system parameters. Future feed and animal productivity options to meet those targets will be explored using whole farm productivity and profitability modelling.

People and facilities

Team led by Dr John Rendel and including Dr O. Montes de Oca Munguia.

Types of output

Examples of changes that may need to be made at a whole farm systems level to meet future productivity gain targets for the industry.

Future research and farm systems design to allow individual farmers to continue to optimise their farming system while improving profitability and efficient land use.

Implementation pathway for outputs

There is no single medium for knowledge and technology transfer. However, Focus Farms are an important component of practice change within the deer farming community. For example, it is suggested that one Focus Farm be dedicated to achieving the targets by adoption of the systems changes recommended by the project's outputs. This may present the opportunity to implement on farms with deer systems aspects of Pasture21 research programme modelling.

Specific work being undertaken in 2013/14

A report will be presented on use of the Integrated Farm Planning Model to identify potential feed gaps and quantify the costs and benefits of filling those gaps for a mixed livestock farming system to economically achieve the targets of the Passion2Profit Programme. Two academic papers on whole farm systems analysis will be written for science journals.

MANAGING WATER QUALITY IN HILL AND HIGH COUNTRY SYSTEMS

What is already known in the area?

The grazing patterns and vegetation usage/selection of deer on a range of high country farms has been identified in three previous studies.

Research spectrum

H2-H1

New knowledge to be generated by the research

This study will determine whether the previously identified selective grazing behaviour of deer is altering the plant species diversity of tussock grassland paddocks, which in turn has implications for both the long term stability of these ecosystems and also the potential productivity of these ecosystems in terms of deer production.

Hypotheses or research questions addressed

Is the selective grazing behaviour of red deer in High Country tussock grassland paddocks causing the distribution and diversity of plant species within these paddocks to change over time? Are there ways to mitigate the impacts of deer on water quality in hill and high country systems without significantly compromising profitability?

Project design

A detailed ground survey of the vegetation in a High Country tussock grassland paddock at White Rock Station in South Canterbury was conducted in the early spring of 2008. This survey will be repeated in September 2013 to compare how the distribution of plants species and also their richness and diversity has changed over time under deer grazing.

People and facilities

Team led by Dr A.Wall (AgR) and includes botanists from Otago University. Field work will be conducted on a commercial farm (Whiterock Station).

Types of output

Knowledge on how deer utilise and affect native vegetation on high country farms. Advice and guidelines for managing biodiversity in and water quality impacts of high country deer farming systems.

Implementation pathway for outputs

Guidelines on managing deer in hill and high-country environments developed for the Productivity Improvement Hub. New environmental knowledge on the effect of deer on biodiversity and water quality in high country systems, as published in peer reviewed science journals, will be available for use by internal deer industry and external environmental policy-makers when making policy and regulations in this sphere.

Specific work being undertaken in 2013/14

Advice on managing high-country biodiversity and the development of a research plan around water quality impacts of deer farming in hill and high country environments.

ADOPTION AND PRACTICE CHANGE

What is already known in the area?

Adoption and practice change techniques have been developed by AgResearch's Deer group, based on other successful models, and specifically include Learning Packages and Focus Farms.

Research spectrum

H1: practice change

New knowledge to be generated by the research

This project continues exploring options to improve science delivery on farm and interact with various industry participants to meet future science delivery needs

Implementation pathway for outputs

Resources already developed through the 'Improving Weaning Performance' Learning Package will be available as requested by the farming audience. The placement of these resources will depend on relevance to each audience. Science outputs will be promulgated through the Focus Farms and media channels such as Deer Industry News, the Productivity Improvement Hub and deerfarming.co.nz. Social science advice on the Advance Parties practice change model will be communicated to Deer Industry New Zealand for it to incorporate in its updates of the model.

People and facilities

Team led by Dr David Stevens and includes Dr Geoff Asher, Dr Julie Everett-Hincks, Dr Colin Mackintosh and other research personnel, such as a social scientist. This team has a high profile within the industry as communicators of proven quality and trusted advisers, and has over 100 years of combined experience of delivering to farmers. Team members have been recognised by their peers and clients through awards for science delivery in the sheep, beef and deer industries.

Types of output

Best practice advice and advice to the deer industry on new and/or improved models for achieving practice change.

Specific work being undertaken in 2013/14

- Delivery of a modified Learning Package guideline document for science delivery in line with recommendations from the 2012 Focus Farm review and the Payne 2013 Learning Package review.
- Development of up to 4 new modules for the 'Improving Weaner Growth' learning package and delivery of these to at least 3 Focus Farm audiences.
- Maintenance of the financial and logistical input into 4 Focus Farms.
- Development of a framework for future science delivery in line with the Productivity Improvement Programme goals and the NZDFA and DINZ's needs
- Analysis on the efficacy of the Advance Parties model of achieving practice change and advice on improvements to it

SEASONAL GROWTH PATHWAYS

What is already known in the area?

A significant body of research has been done on both the seasonality of deer growth and feeding. Much has been summarised for the industry in several publications including Q-Graze for Deer and 'The Nutrition and management of deer on grazing systems' (Casey 2003).

Research spectrum

H3-H2

New knowledge to be generated by the research

An understanding of the role of genetics on seasonality of growth and the identification of potential 'outliers' (such as deer whose growth peaks early (spring) or late in the season (autumn)) whose selection may assist in altering future liveweight growth profiles to better meet industry targets.

Hypotheses or research questions addressed

What is the genetic and physiological basis for late and early season growth in deer?

Project design

A review of available data will be conducted to see if 'outliers' to seasonal growth can be identified. If such data is not apparent, a field experiment to identify and assess growth stage outliers will be developed. If the data is available, an experiment will be designed to investigate the physiological and genetic basis for early or late growth. If the outcomes suggest that no relevant relationships exist, the project will be terminated.

People and facilities

Team led by Dr David Stevens and including Dr Chris McMahon and Dr David Pacheco. Field studies will be conducted on the AgResearch Invermay deer farm.

Types of output

- Knowledge and understanding (of variation in seasonal growth patterns of farmed deer and their interactions with feeds and feed supply);
- Research tool: potential identification of heritable traits related to seasonal regulation of feed intake and growth
- Farmer tool: potential ability to generate breeding values within DEERSelect for growth pathways aligned to feed availability in particular deer systems and climatic zones to produce high quality carcasses at the size and time required by the market.

Implementation pathway for outputs

Breeding values for seasonality would be implemented through DEERSelect.

Future research may define interactions between feed types and rumen function

Outputs from that research may be incorporated into farm systems modelling under the Achieving Productivity Targets project, to understand any required whole farm changes

Best management advice guidelines may be developed for extension through the Adoption and Practice Change project.

Specific work being undertaken in 2013/14

Collation and review of feeds available for deer with recommendations on areas of potential research.

Initial evaluation of data within DEERSelect.

Development of a research plan for assessing and analysing within-herd and between-herd variation in seasonal growth patterns.

Commencement of field trial, if required.

PHYSIOLOGY OF PUBERTY

What is already known in the area?

Past studies that have focused on the influence of body mass on attainment of puberty in 16-month old hinds identified a putative effect of early-life growth on the required liveweight threshold.

Research spectrum

H3 (core/fundamental)

New knowledge to be generated by the research

Knowledge on how growth between birth and weaning (3 months of age) influences body compositional changes as hinds approach the normal age and season of puberty.

Hypotheses or research questions addressed

That early-life growth determines body composition relative to body mass as hinds approach the age of puberty, influencing the permissive body mass threshold for attainment of puberty.

Project design

80 young red deer hinds selected on the basis of either high or low growth opportunities within their first 3 months of life (i.e. high v low nutritional level to their dams during the suckling period) will be nutritionally managed to attain a similar body mass by 16 months of age.

Body compositional changes will be monitored by isotopic techniques and will be correlated with reproductive parameters between 16 and 18 months of age.

People and facilities

Team led by Dr Geoff Asher and including Dr Chris McMahon (Grasslands). The field work is based at the Invermay deer farm.

Types of output

Peer-reviewed international science journal publications.

Best practice management advice for managing growth of young female deer to enhance lifetime reproductive performance.

Implementation pathway for outputs

The knowledge discerned is capable of leading to H2 research strategies for enhancing the pregnancy rate of R2 hinds, the outputs of which could be channelled through Focus Farms and the Productivity Improvement Hub.

Specific work being undertaken in 2013/14

Fieldwork

THEME 3: ANIMAL HEALTH

MANAGING DEER PARASITES

What is already known in the area?

Previous studies have measured the effects of subclinical parasitism on production in weaners and compared Red and Wapiti-cross deer, refined diagnostics tests for parasites, assessed the value of the salivary CARLA test for deer, identified the most important parasite species affecting deer, investigated the infectivity of sheep parasites for deer and evaluated various anthelmintics delivered by three different routes (oral, injection and pour-on).

Research spectrum

H3-H1

New knowledge to be generated by the research

A cross-grazing study to assess the value of using sheep and cattle to reduce parasite challenge in weaners will be completed and results analysed; the effects of mineral additives on the efficacy of oral anthelmintics will be measured; the infectivity of cattle parasites on deer will be assessed and a survey of anthelmintic resistance on NZ deer farms will be initiated.

Hypotheses or research questions addressed

Cross-grazing cattle and/or sheep with deer will reduce parasite challenge with minimal adverse effects and reduce reliance on anthelmintics.

Mineral additives increase efficacy of macrocyclic lactone (ML) anthelmintics in young deer by stimulating oesophageal groove closure and directing the dose directly into the abomasum, resulting in high maximum plasma concentrations.

Anthelmintic resistance is a becoming widespread in the NZ deer industry. Wapiti (and possibly "eastern strains" of Red deer) are more susceptible to parasites than "western" Red deer, but marker-assisted selection may increase their resistance/resilience.

Project design

Species cross-grazing

- *Field:* deer grazed alone or cross-grazed with either sheep or cattle. Trigger treatments of anthelmintic, regular faecal sampling and liveweight measurements. Deer euthanased at 8 or 16 weeks. Lungs and GI tracts collected.
- *Laboratory*: assessment of the parasite types and burdens in the deer (by faecal egg and larvae counting, faecal culture and total worm counts of lungs and GI tracts).
- *Analysis:* assessment of groups differences based on number of trigger treatment, worm types, burdens and liveweight gain.

Effects of mineral additives on the efficacy of oral moxidectin and abamectin on resistant parasites

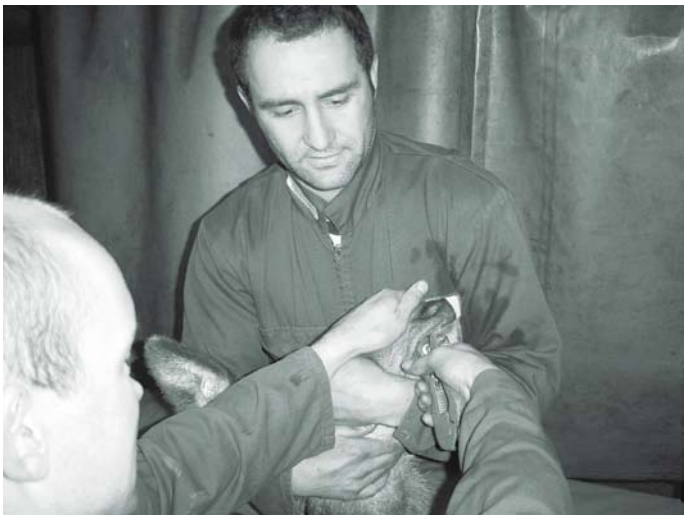
- *Pen:* 4 groups of moderately parasitised red weaners treated with either anthelmintic+/- mineral additive, and one untreated control group. Faecal sampling. Blood samples taken 12 hours post drenching. Deer euthanased 2 weeks post-treatment.
- *Laboratory:* full worm counts; determination of blood levels of abamectin and moxidectin post-treatment.

Cross-infectivity of cattle-origin parasites in red deer weaners

- *Pen:* red deer weaners artificially challenged with cattle-origin parasites, with young cattle as a control. Faecal sampling. Deer and cattle to be euthanased at 28 days.
- *Laboratory:* Faecal egg and total worm counts to assess types and relative burdens of parasites in each species.

People and facilities

Team led by Dr Colin Mackintosh, including Dr David Leathwick and Prof. Bill Pomroy (Massey University). Field work will mainly be carried out on the AgResearch Invermay and Massey University deer farms.



Types of output

- Improved knowledge on control of parasitism.
- Farmer- and vet-focussed advice on-
  - practical control measures to minimise inappropriate drench use;
  - tailoring drenching regimens to specific farm systems and genotypes; and
  - minimising drench resistance.

Implementation pathway for outputs

Publication of core/fundamental science in refereed science journals.

Results of that science can lead to H2 research strategies for enhancing parasite control in farmed deer, with its outputs channelled through Focus Farms and Productivity Improvement Hub.

Adoption of practical control measures encouraged by field days, papers at NZVA Deer Branch conferences, lay articles in industry magazines and best-practice modules and learning packages within the Productivity Improvement Hub.

Specific work being undertaken in 2013/14

Species cross-grazing studies: Laboratory work and reporting.

Study on effects of mineral additives on the efficacy of oral ML anthelminthics: fieldwork planning and initiation.

Cross-infectivity of cattle-origin parasites in red deer weaners study: fieldwork planning and initiation.

Nationwide monitoring of anthelmintic resistance: detailed planning.

TOXOPLASMA VACCINATION STUDY

What is already known in the area?

An initial survey in 2012 across deer farms identified variable but economically significant levels of foetal wastage for red deer hinds on some farms, particularly for pubertal (R2) hinds. Causation has not been investigated, but there is compelling evidence that *Toxoplasma gondii* infection may be implicated in some herds.

Research spectrum

H2-H1

New knowledge to be generated by the research

A *Toxoplasma* vaccination study will provide further resolution around the putative role of this organism in foetal wastage.

Hypotheses or research questions addressed

Vaccination of R2 hinds against Toxoplasma will reduce incidences of foetal wastage and improve overall reproductive performance of R2 hinds

Project design

50% of the hinds in each R2 cohort of 8 commercial Red deer herds will receive *Toxoplasma* vaccine prior to first joining. Reproductive performance and the incidences of foetal loss will be measured by repeat ultrasound scanning over the pregnancy period. A sample of hinds on each farm will be monitored by blood sampling for seroconversion to indicate the level of natural *Toxoplasma* infection (in control hinds) and the efficacy of vaccination (in treated hinds).

People and facilities

Team led by Dr Geoff Asher (AgR). The vaccination study will involve 8 Landcorp farms. Vaccine provided gratis by MSD Animal Health.

Types of output

Knowledge: determination of the efficacy of *Toxoplasma* vaccination in reducing foetal wastage in R2 hinds

Image:Jason Archer Foetal Scanning

Implementation pathway for outputs

Results of studies will be submitted for publication in refereed science journals. If Toxoplasma vaccination proves efficacious in improving calving rates through reductions in abortion, the next step will be to optimise the therapeutic protocol (timing of vaccination and dosage) through a further field trial with the vaccine manufacturer with a view to promotion by the manufacturer and veterinarians of routine vaccination of R2 hinds.

Specific work being undertaken in 2013/14

Repeat of *Toxoplasma* vaccination study on R2 hinds: planning and commencement.

THEMES 4 & 10:
GENETICS & TRACEABILITY

DEER PROGENY TEST (DPT)

What is already known in the area?

Knowledge that genetic gains are permanent and cumulative and the proven superior performance of deer herds subject to a genetic breeding programme shows that genetic selection of farmed deer for improved biological and economic performance is pivotal to the national herd collectively achieving the industry's profitability targets.

Research spectrum

H2-H1 (applied science and practice change)

New knowledge to be generated by the research

- Genetic evaluation of industry proven maternal and terminal stags.
- Understanding whether meat yield, relative weighting of primal muscles and meat quality is heritable.
- New trait breeding values (BVs) and indices (from field and carcase data that is heritable)
- Better understanding of the heritability of multiple traits for future BV development.

Hypotheses or research questions addressed

The research will investigate the heritable nature of specific traits of relevance to deer farming profitability.

Project design

The DPT project completed its 3rd and final artificial insemination programme in April 2013. On-going phenotype recording of terminal progeny will be completed by December 2014 when the final cohorts of progeny are slaughtered. Recording of maternal traits (mainly reproductive performance of female Red progeny) will continue until the last retained hinds reach R4 age.

People and facilities

The science will be led by Dr Julie Everett-Hincks. Project management will be done by Helen Mathias-Davis. Field work will be done at AgResearch Invermay and commercial deer farms (Whiterock Station, Haldon Station and partner herd properties). Slaughter of DPT progeny and assessment of carcass traits will be done in collaboration with Alliance Group Ltd.

Types of output

Improved linkage for breeders that contribute genetics driving the DEEResearch research targets. Data that can be directly incorporated into DEERSelect's existing breeding values and indices. Reports via deer industry media such as the Deer Industry News. AgResearch will encourage Focus Farms to allow progress reports to be given.

Recommendations to DEERSelect for Module development for determination of BVs and/or indices in DEERSelect for novel traits e.g. parasite resistance/resilience based on the CarLA production. Opportunities for scientists to publish trait analyses in refereed science journals.

Implementation pathway for outputs

Data will be incorporated into DEERSelect where applicable. For example, linkage data will be incorporated into DEERSelect reports and made available to breeders and purchasers when making breeding and purchasing decisions.

Recommendations for DEERSelect development will provided to Deer Industry New Zealand's DEERSelect Stakeholder Reference Group for consideration. DNA collected from DPT animals will form a resource for future genomic technologies.

Specific work being undertaken in 2013/14

- DPT project: recording of reproduction, growth and meat yield traits from the DPT herds; analysis of meat quality and co-product traits collected in the 2012 DPT progeny slaughter; determination and prioritisation of traits to be collected at the 2013 slaughter of DPT progeny.
- Determination of format and structure of a future industry multiple trait collection and genetic evaluation programme to succeed the DPT project, in consultation with deer industry participants. Investigation of the feasibility of CarLA testing in such a programme. Implementation of structure of new programme.

DEERSELECT

What is already known in the area?

There is already a national genetic evaluation system for deer called DEERSelect.

Research spectrum

H1 (practice change)

New knowledge to be generated by the research

An improved and/or expanded tool for deer breeders to maximise genetic gain.

Project design

New trait modules will be developed and existing modules updated in line with science outputs from the Deer Progeny Test Project.

People and facilities

The people working on this theme will be a team of quantitative geneticists, research assistants, statisticians, bioinformatics specialists, animal physiologists and economic modellers led by AgResearch's expert livestock geneticist Dr Sheryl-Anne Newman.

Types of output

- improved or streamlined systems for monitoring and recording herd data and supporting tools (e.g. on-line foetal ageing tutorial for ultrasound operators supported by a field notebook) formal and automated data monitoring tools, new analytical procedures.
- revised genetic parameters, economic weights and models underpinning existing genetic evaluation indices;
- software development arising from quantitative genetic analyses.
- regular reporting of breeding values and indices, new trait breeding values and indices;

Implementation pathway for outputs

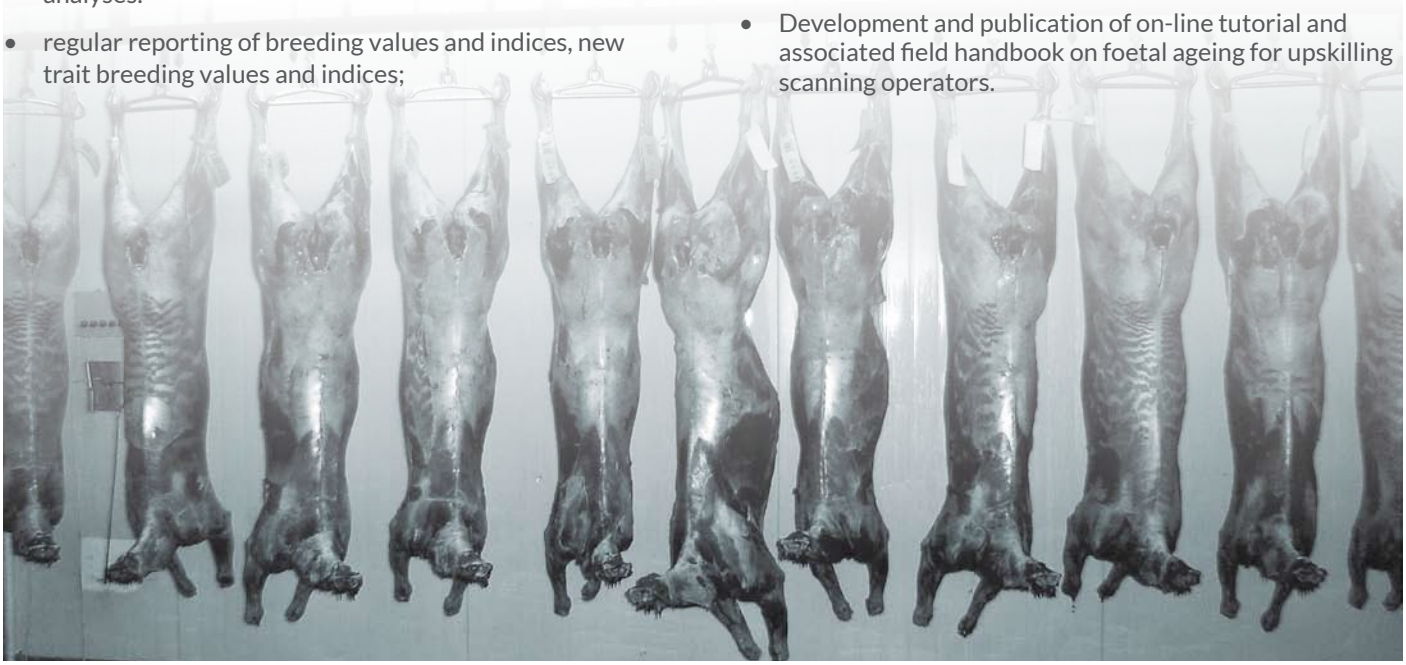
Improvements to DEERSelect is the major implementation pathway for project outputs.

Practice change – to use DEERSelect and refine the quality of data put into it – will be through-

- stud breeders and commercial farmers being encouraged to use DEERSelect in decision-making through demonstration of its improved functionality; and
- deer scan technicians being encourage to make use of the foetal ageing tutorial.

Specific work being undertaken in 2013/14

- Regular generation of fit-for-purpose breeding values, indices and linkage data.
- In collaboration with DINZ's DEERSelect Manager development and documentation of standard operating procedures for DEERSelect.
- Development of formal monitoring tools for DEERSelect.
- Review of animal ID recording and the integration of NAIT Tags into DEERSelect.
- Review traits (names, abbreviations, descriptions) in DEERSelect.
- Implementation of revised indices in DEERSelect.
- If desired by industry, determination and publication of "Potential Stag List" of top DEERSelect ranked yearling stags (i.e. with no progeny) aimed at breeders for improving rate of genetic gain without requiring detailed perusal of progeny-tested DEERSelect results.
- Development and publication of on-line tutorial and associated field handbook on foetal ageing for upskilling scanning operators.



GENOMICS

What is already known in the area?

Farmed deer in NZ are derived from several progenitor breeds. DEERSelect's ability to estimate breeding values (the worth of an individual deer based on its genetics) is dependent on knowing the relatedness of individuals to those progenitor breeds and an animal's direct parentage. Genetic marker-based tests are routinely used for assigning parentage and estimating the breed composition. However, parentage platforms available to the deer industry are outdated and sub-optimal. There is a need to identify genetic markers in a new, accurate parentage test that can be used in rapid modern analysis.

Research spectrum

H2 (applied science)

New knowledge to be generated by the research

Identification of thousands of high quality genetic markers within the national herd that segregate in a useful way for determination of parentage and breed composition. We will gain unprecedented knowledge of genomic architecture in the global cervid population.

Hypotheses or research questions addressed

How do allele frequencies differ and what is the measure of relatedness between deer breeds and sub-species using genomic markers?

The accuracy of prediction of parentage and breed composition using genetic markers is improved through identification of diagnostic single nucleotide polymorphisms (SNPs).

Can we use these tools for traceability and product differentiation?

Project design

Obtain samples of breed standards representing the NZ deer industry, use SNP arrays and genotyping by sequencing to find SNPs differing in allele frequencies, and mount on the most suitable platform.

People and facilities

The Genomics sub-project will be led by Dr Suzanne Rowe.

Types of output

Knowledge:

- Identity of the diagnostic SNPs presently embedded within a 50k deer SNP array that have utility in accurate parentage testing, breed assignment and subspecies forensics.
- Novel diagnostic SNPs in breeds poorly represented on the array using genotyping by sequencing methodology.

Implementation pathway for outputs

Breed and parentage diagnostic SNPs will be made available to commercial gene testing laboratories in test developments to develop or improve tests for commercial use. One such laboratory (GenomNZ) will use this project's outputs to convert from a microsatellite platform-based test to a SNP platform. Another (Genemark) will have access to a greater array of diagnostic SNPs than presently available for its gene diagnostic tool. SNPs identified on this sub-project will become public domain knowledge.

Specific work being undertaken in 2013/14

Identification of SNPs that have utility for accurate parentage, breed and sub-speciation diagnostic tests.

THEME 5: ENVIRONMENT (WATER)

IMPROVING OVERSEER FOR DEER

What is already known in the area?

A Deer module for the Overseer nutrient budget model has previously been developed, documented and implemented.

Research spectrum

H2-H1

New knowledge to be generated by the research

This project will identify the gap between Overseer's estimates of nutrient cycling on deer farms and current industry practice.

Hypotheses or research questions addressed

What components of the Overseer nutrient budget model need to be modified, and what additional research is required to increase both the accuracy and robustness of Overseer for use in deer farming systems?

Project design

A critical review of Overseer's current deer system assumptions and nutrient cycling models/calculations will be done to identify any weaknesses or significant gaps. A review will be undertaken of the land classes, soil types, and diverse farm management practices currently used by deer farmers to assess Overseer's current and potential capacity to adequately account for them in its nutrient loss estimations.

People and facilities

Team led by Dr R.Muirhead and including Drs R.McDowell, A.Wall and other soil/water scientists.

Types of output

Recommendations that enable refinement of Overseer into a 'fit-for-purpose' version of Overseer that has relevance to current deer farming and mixed livestock farming systems that include deer.

Implementation pathway for outputs

Amendment of Overseer if required, followed by confidence by Deer Industry New Zealand that it can endorse the use of Overseer by deer farmers if appropriate for the particular deer farming system and location.

Specific work being undertaken in 2013/14

Review deer inputs into Overseer, and identify strengths, weaknesses and gaps. Assess the range of soils and landscapes that deer farms currently occupy and compare with the ranges embedded in Overseer. Identify typical farm management practices used by deer farmers and assess whether these practices are able to be effectively modelled in Overseer.

TACTICAL INVESTMENTS

In addition to long-term investments and research partnerships, DEEResearch sees value in investing in projects with a narrow focus so long as they meet a DEEResearch research objective. DEEResearch's investment may either be as a co-funder alongside other interested parties or it may solely commission the research project. Generally, for DEEResearch to make a one-off tactical investment-

- a significant focus of the work must be on deer or venison;
- relevant foundation research that would be common to other ruminant species has already been done; and
- there should be a clear pathway from the best-case outputs to on-farm or in-plant practice change, even if some further intervening research and/or development may be required.

Dr Colin Mackintosh, Liam Brennan and Simon Liggett.

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo

BIOMARKERS FOR RESISTANCE AND SUSCEPTIBILITY TO JOHNE'S DISEASE

What is already known in the area?

While researchers agree that host genotype makes an important contribution to Johne's disease manifestation (phenotype), nobody has identified the underlying mechanisms. Genome-wide association studies have not charted the relevant genes, which is not surprising considering that disease resilience involves multiple genes acting in concert. The project will initially use H3 (fundamental) knowledge to generate a H1 (applied) outcome.

Hypotheses or research questions addressed

The working hypotheses are that: dysfunctional regulation within host macrophages allows *Mycobacterium avian paratuberculosis* (MAP) infection to become established, resulting in emergence of Johne's disease in deer of the susceptible (S) phenotype; protective immunity from Johne's disease – the resilient (R) phenotype - is dependent upon competent T cell function.

Project design

The scientific concept underpinning this project is that a systems biology approach can be used to identify a small group (5-10) of gene markers (transcriptional biomarkers) from macrophages and T cells, to classify animals as R or Sto MAP infection.

Experimental animals bred from sires with S or R genotypes, have been experimentally infected at 4-5 months of age and the responses generated by their macrophages and T cells monitored for 6 months post infection. Initially a panel of 66 genes were screened to select a smaller group of markers (20-30) that were most informative in distinguishing between S and R animals. Further studies are underway to confirm that gene markers expressed in experimentally infected animals can be duplicated using non-specific disease stimulants (polyclonal activators) in samples from non-infected animals. If this is the case, a blood sample of an animal whose disease status is unknown can be tested for its likely response under field exposure to MAP by assessing its response in the lab to the stimulant – the basis of a test for R or S phenotype.

People and facilities

The field studies are carried out under subcontract to Dr Colin Mackintosh at AgResearch's Invermay campus. All laboratory studies are performed at the Disease Research Laboratory, University of Otago under the direction of Prof. Frank Griffin. Laboratory supervision is provided by Dr Rory O'Brien and diagnostic support provided by Mr Simon Liggett. Three postgraduate students (Liam Brennan (PhD), Tim McCulloch (MSc) and Alex Morrison (BSc. (Hons))) are directly involved with the experimental laboratory studies.

Types of output

The primary output for this project is to develop a set of markers of gene expression that can be used to identify animals that would exhibit polarized S or R traits to mycobacterial infections. A secondary output will be improved methods for disease diagnosis in S animals and to chart protective pathways of immunity in R animals, that could be the target for future vaccine studies.

Implementation pathway for outputs

Refine the list of candidate markers for R and S animals to select the minimum number necessary to characterize the R and S disease phenotypes. As part of this work, metrics must be developed to produce diagnostic assays against which each tested animal can be measured that take into account, through appropriate weightings, the contributions of each R marker to the composite polarised R phenotype and of each S marker to the composite polarised S phenotype.

Specific work being undertaken in 2013/14

Continue to refine laboratory assays for gene markers from experimentally infected deer to identify the smallest array of genes necessary to distinguish between deer that display either a R or S phenotype. Scale down technology so that it can be used on relatively small blood samples (10-20ml).

Image: Gene Marker Assays – Dr Rory O'Brien.

FOETAL WASTAGE

What is already known in the area?

A pilot study in a clinical context on 4 farms during 2010-11 showed mid-term abortion rates of 2-16% in yearling hinds, contributing to lowered calving and weaning rates. Evidence of aborting foetuses at scanning suggested that abortion may also be contributing to lowered pregnancy rates. *Toxoplasma* tests were positive, but causation could not be confirmed.

New knowledge to be generated by the research

- Quantification of deer foetal wastage nationally
- Determination of infectious and/or other cause(s)
- Understanding of the biology (epidemiology) of infectious agents identified, to underpin control strategies
- Investigation of potential control measures as appropriate
- Economic analysis of impacts of foetal wastage and cost-benefit of solutions

Hypotheses or research questions addressed

- That abortion contributes significantly to reproductive inefficiency in farmed deer
- That causation is infectious
- Mitigation strategies can be devised once cause(s) known

Project design

Over two years (2012-13), 96 farms across NZ will have yearling and adult hinds scanned for pregnancy at the usual time, but repeat scanned later in gestation to establish mid-term abortion rates. Blood samples will be collected from pregnant and non-pregnant deer at first scan, and aborted and non-aborted at the second scan. Non-pregnant uteri, uteri of aborting hinds and aborting foetuses will be collected.

Massey University

Early abortion will be investigated, i.e. prior to "normal" time for first scan. Data on farms and animals relevant to abortion investigations will be collected.

Abortion rates will be estimated, as will their repeatability between years within farm. Samples will be evaluated for pathogens by tests (such as serology and PCR) to be validated as part of the project. Multivariable analysis of farm data against abortion rates will be undertaken.

People and facilities

Institute of Veterinary, Animal and Biomedical Sciences, Massey University: Professor Peter Wilson (Project leader), Kandarp Patel (PhD candidate), Prof. Cord Heuer, Dr Laryssa Howe, Dr Geoff Asher (AgResearch). Sampling will be done on commercial farms and sample analysis undertaken at Massey University laboratories.

Types of output

Knowledge - see above. Additionally, potentially best practice recommendations for minimising foetal wastage, depending on results.

Implementation pathway for outputs

Science journal and deer industry lay publications, best practice advice communicated at field days, conferences and on the Productivity Improvement Hub.

Specific work being undertaken in 2013/14 year

On-farm scanning and sample collection from 45 farms. Development and validation of tests. Selection and testing of appropriate samples for various testing regimes from collected samples, and if appropriate, serum bank samples from previous projects to improve understanding of epidemiology of pathogen(s) if implicated.

DEERESEARCH BUDGET 2013/14

	DEER INDUSTRY NEW ZEALAND CONTRIBUTION ($)	AGRESEARCH CONTRIBUTION ($	THIRD PARTY CONTRIBUTIONS ($)
Hitting Targets for Deer Industry Profitability (AgResearch)	408,000		
1.1 Achieving productivity targets	25,390	82,939	
1.2 Managing water quality in hill and high-country systems	10,447	34,128	
1.3 Adoption and practice change	44,261	144,585	
2.1 Seasonal growth pathways	22,498	73,493	
2.2. Physiology of puberty	36,494	119,212	
3.1. Managing deer parasites	51,615	154,310	50,000
3.2. Foetal wastage	12,064	54,085	50,000
4.1. Deer Progeny Test	105,219	343,567	95,000
4.2. DEERSelect	47,501	155,169	
4.3. Deer Genomics	34,304	112,060	
7.1 Improving Overseer for deer	18,207	59,513	
Johne's Disease Research Consortium (management of Johne's disease)			
Pastoral Greenhouse Gas Research Consortium (methane and nitrous oxide management)	35,000		
Pastoral Genomics (improved forage production)	34,000		
Molecular markers for resistance and susceptibility to Jd	80,000		
Foetal Wastage	20,000		
Discretionary Funds (pending Board approval)	34,000		
Anthelmintic dose determination studies	34,000		
Administration	30,000		
SUB-TOTAL	641,000	1,333,061	195,000
TOTAL			**2,169,062**

Notes:

DEEResearch will also pay AgResearch a further $60,000 held over from the 2012/13 year to complete various projects that were behind schedule in that year under the Venison Supply Systems Programme.

Whilst the Johne's Disease Research Consortium (JDRC) will be undertaking deer-specific research (see page 6), it will be doing so under investments made by Consortium partners prior to the 2013/14 year. No further capital contributions from DEEResearch or other partners will be required to complete JDRC's current projects.

Third party contributions to Managing Deer Parasites and the Foetal Wastage sub-projects of Hitting Targets for Deer Industry Profitability are from Landcorp.

Third party contributions to the DPT sub-project of Hitting Targets for Deer Industry Profitability are from Landcorp ($25,000) and Alliance Group ($70,000).

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