Faculty of Agriculture and Life Sciences

Summer Scholarships

2023/2024

LINCOLN UNIVERSITY

TE WHARE WĀNAKA O AORAKI

Scholarship Information

The Faculty of Agriculture and Life Sciences will be offering a number of research scholarships over the 2023/2024 summer vacation to capable students who are considering continuing their university studies in 2024. All scholarships are valued at $6,000 each (tax free), commencing after the end of the semester two, for a period of 12 working weeks (includes 3 weeks University Christmas close down period).

The scholarships are an opportunity for students to experience working in a research environment, to get a feel for what's involved in postgraduate research, and to gain valuable research skills. Many of the students who have previously been awarded summer scholarships have gone on to complete postgraduate degrees and establish successful careers.

This booklet outlines the summer scholarship projects received to date. Please consult the Lincoln University website for others that may have been added subsequently.

https://www.lincoln.ac.nz/study/scholarships/
Browse **Search Scholarships**
Select **Agriculture & Life Sciences Summer Scholarships**

Applications close on **Friday 29th September 2023,** and should be sent to:

Robyn Wilson
Faculty of Agriculture and Life Sciences
PO Box 85084
Lincoln University
Lincoln 7647
Christchurch
Robyn.Wilson@lincoln.ac.nz
Phone: (64) (3) 423 0652
Science South - Room 45

Eligibility

Applicants must be students intending to undertake full-time study in 2024.

You may be continuing your Bachelors degree, or planning to begin an Honours, Masters, or PhD degree in 2024. Priority will be given to those students who are undertaking their studies at Lincoln University.

Current Masters and PhD students are not eligible to apply for this scholarship.

All applicants for this scholarship need to be currently residing in New Zealand.

Applications

(Note: there is no official application form)
Please provide the following information:

- Name, student ID, address and contact details (include email address)
- Current degree being studied for
- Intended qualification to study for in 2024
- Project(s) you would like to work on (include the project number)
- Copy of your Academic Record
- Relevant previous work and/or research experience

An application for a maximum of 3 or 4 projects is considered appropriate. Please list in order of preference.

NOTE: All applicants must contact the lead supervisor listed at the bottom of each project prior to submission of their application.

Financial information

- Scholarship payments will be made fortnightly, with a final payment made on receipt of your approved project report, at the completion of the 12 working weeks.
- **For taxation purposes applicants must be intending to undertake full-time study in 2024.** (You may be continuing your Bachelors degree, or planning to begin an Honours, Masters, or PhD degree in 2024.)
- Students who receive Study Link funding should contact Study Link directly, prior to applying, as there may be implications for their funding.

Timetable

- Friday 29th September 2023 Deadline for applications
- Friday 13th October 2023 Successful applicants notified
- Monday 13 November or or Monday 20 November 2023 Scholarship research period begins
- Friday 23 February 2024 Final scholarship report due

Working conditions

The minimum expected hours of work will be 37.5 per week to be worked between Monday and Friday inclusive, between the hours of 7:00 am and 9:00 pm. This includes a meal break of 30 minutes and a refreshment break of 10 minutes within each three-hour continuous work period. From time to time you may be required to work outside of normal working hours. Working hours are to be negotiated with your supervisor. If any deviation to the original plan is made, then this **must** be approved by the Faculty Research Committee.

Criteria for awarding these scholarships

The criteria for awarding these scholarships take the following attributes of applicants into consideration:

Academic achievement
- Overall Grade Point Average (GPA)
- Last Semester GPA

Applicant's background
- Suitable subjects covered during study
- Suitable work/research experience

Intentions for future study
- Continuing within Bachelors degree
- Bachelors degree to be followed by Honours, Masters, or PhD

Scholarships will be awarded based on academic merit. The Faculty reserves the right to award the number of scholarships for which it believes it has suitable candidates and funding.

Guidelines for Summer Scholarship Final Report

Your final report for your scholarship should include the following:

- **Title page** – including name, supervisors and project title.
- **Abstract** – gives a brief summary of the project.
- **Introduction** –outlines the background to your summer research project, concluding with an outline of the objectives of the research you were involved in.
- **Methods** – this section covers the work carried out, described to a level equivalent to that given in a scientific paper.
- **Results** – a summary of results or achievement.
- **Discussion** – of results/achievements and how those linked with their objective and wider project objectives, if applicable.
- **Benefits of the scholarship** – your reflection on what you gained from the scholarship.
- **References cited/appendices** – if applicable.

Please provide an electronic and printed copy of your report to your supervisor(s) by Friday 23rd February 2024.

Once your supervisor has approved your report and advised Robyn the final scholarship payment will be made.

List of Projects

No.	Project Title	Supervisor and email
1	Advancing bee health: Exploring natural solutions for Varroa Mite management	Dr. Artemio Mendoza-Mendoza Artemio.Mendoza@lincoln.ac.nz
2	Aluminium toxicity in high country soils	Assoc. Prof Jim Moir Jim.Moir@lincoln.ac.nz
3	Animal breeding for improved resilience in hot climates	Dr. Racheal Bryant Racheal.Bryant@lincoln.ac.nz
4	Balansa clover seed germination responses to different water potential and temperature	Prof. Derrick Moot Derrick.Moot@lincoln.ac.nz
5	Biases biodiversity and big data	Dr. Will Godsoe William.Godsoe@lincoln.ac.nz
6	Caucasian clover (Cc) seed production and Cc / plantain pasture production	Dr. Tom Maxwell Tom.Maxwell@lincoln.ac.nz
7	Characterisation of a novel type 2 DNA transposon isolated from Mendel's hawkweed	Assoc. Prof. Chris Winefield Chris.Winefield@lincoln.ac.nz
8	Collection and curation of entomological specimens for teaching	Dr. Cor Vink Cor.Vink@lincoln.ac.nz
9	Collection of entomological specimens for teaching and waterway monitoring	Elysia Harcombe Elysia.Harcombe@lincoln.ac.nz

No.	Project Title	Supervisor and email
10	Crafting gluten-friendly beer: Strategies for gluten reduction in craft beer	Dr. Leo Vanhanen Leo.Vanhanen@lincoln.ac.nz
11	Decoding nature's secrets: Investigating plant communication with beneficial microbes	Dr. Artemio Mendoza-Mendoza Artemio.Mendoza@lincoln.ac.nz
12	Detecting parasites through autofluorescence	Dr. Andy Greer Andrew.Greer@lincoln.ac.nz
13	Developing a bioherbicide for giant buttercup	Prof. Rainer Hofmann Rainer.Hofmann@lincoln.ac.nz
14	Developing metrics to evaluate braided river health	Dr. Naomi Wells Naomi.Wells@lincoln.ac.nz
15	Developing new and non-invasive techniques for managing lizard populations on Banks Peninsula	Dr. Jennifer Gillette Jennifer.Gillette@lincoln.ac.nz
16	Diversity of Phytophthora species at Lincoln University	Dr. Helen Rees Helen.Rees@lincoln.ac.nz
17	Dryland pastures – Regen Ag farmlet (two summer scholarships)	Prof. Derrick Moot Derrick.Moot@lincoln.ac.nz
18	Effectiveness of different settling techniques and fining agents to reduce elemental sulphur levels in grape musts	Dr. Leandro Dias Araujo Leandro.Araujo@lincoln.ac.nz

No.	Project Title	Supervisor and email
19	Enhanced rock weathering: CO2 sequestration via silicate weathering	Assoc. Prof. Peter Almond Peter.Almond@lincoln.ac.nz
20	Experimental and numerical investigation of soil-water characteristics in pasture soils	Dr. Chamindu Deepagoda Chamindu.Deepagoda@lincoln.ac.nz
21	Exploring technologies to accelerate red wine ageing	Dr. Bin Tian Bin.Tian@lincoln.ac.nz
22	Find hybrid-free habitats to eco-source seeds for Canterbury restoration plantings	Dr. Jon Sullivan Jon.Sullivan@lincoln.ac.nz
23	Geeky geckos Act 2: Using photography and a software package to identify individuals and monitor populations of Woodworthia brunnea, the Canterbury gecko	Dr. Jennifer Gillette Jennifer.Gillette@lincoln.ac.nz
24	Horizon scanning of emerging food safety risks using AI: proof of concept	Prof. Stephen On Stephen.On@lincoln.ac.nz>
25	Hydrothermal times and the emergence of different brassicas	Dr. Pieter-Willem Hendriks Pieter-Willem.Hendriks@lincoln.ac.nz
26	Improving biocontrol of Californian thistle (Cirsium arvense)	Wendy Kentjens Wendy.Kentjens@lincoln.ac.nz
27	Invertebrate survey at Yarrs Lagoon	Elysia Harcombe Elysia.Harcombe@lincoln.ac.nz

No.	Project Title	Supervisor and email
28	Lamb pH and meat quality: studies on biochemical changes in the high pH meat associated with pre-slaughter farmyards stress	Dr. Hannah Lee Hannah.Lee@lincoln.ac.nz
29	Low N farm systems	Dr. Racheal Bryant Racheal.Bryant@lincoln.ac.nz
30	Moss contributions to Aotearoa New Zealand forest fertility	Dr. Naomi Wells Naomi.Wells@lincoln.ac.nz
31	Nitrous oxide emissions from mixed forest-pasture systems	Dr. Naomi Wells Naomi.Wells@lincoln.ac.nz
32	Pasture Persistence – determining factors that drive performance of perennial grass cultivars over time	Dr. Tom Maxwell Tom.Maxwell@lincoln.ac.nz
33	Plantain-based pasture to reduce nitrogen losses from grazing dairy systems	Dr. Omar Al-Marashdeh Omar.Al-Marashdeh@lincoln.ac.nz
34	Propagation of select native New Zealand plants	Dr. Clive Kaiser Clive.Kaiser@lincoln.ac.nz
35	Soil pH and nutrient dynamics of dryland pasture legume species in high country	Assoc. Prof Jim Moir Jim.Moir@lincoln.ac.nz
36	Testing plant interactions with their environment	Prof. Rainer Hofmann Rainer.Hofmann@lincoln.ac.nz
37	The effect of global warming on soil microbes	Dr. Charlotte Alster Charlotte.Alster@lincoln.ac.nz

No.	Project Title	Supervisor and email
38	The minimum shade requirement for livestock	Dr. David Scobie David.Scobie@lincoln.ac.nz
39	The potential of fertilisers as an inhibitor of equine gastrointestinal nematode larval migration	Jasmine Tanner Jasmine.Tanner@lincoln.ac.nz
40	The potential of Pseudomonas and Trichoderma sp. on inhibiting Fusarium sp., causal agents of root rot of peas	Dr. Helen Rees Helen.Rees@lincoln.ac.nz
41	Understanding the role of microbes in resilient soil ecosystems	Prof. Eirian Jones Eirian.Jones@lincoln.ac.nz
42	Understanding the size and pattern of water and nitrogen demand of industrial hemp	Dr. Mariana Andreucci Mariana.Andreucci@lincoln.ac.nz
43	Using a plantain-based pasture to reduce nitrogen losses from sheep grazing systems	Dr. Tom Maxwell Tom.Maxwell@lincoln.ac.nz
44	Using stabilised mRNAs encoding Wuschel to stimulate the formation of somatic embryos in grapevine and Hop cell cultures	Assoc. Prof. Chris Winefield Chris.Winefield@lincoln.ac.nz
45	Vegetation survey at Yarrs Lagoon	Dr. Jennifer Gillette Jennifer.Gillette@lincoln.ac.nz
46	Yield survey and data collation of pastures in New Zealand	Prof. Derrick Moot Derrick.Moot@lincoln.ac.nz

Details of each project available are as follows:

1 Advancing bee health: Exploring natural solutions for Varroa Mite management

The varroa mite, an ectoparasite, presents a significant threat to honeybee populations. This tiny intruder not only feeds on these essential pollinators but also serves as a vector for multiple bee-harming viruses. The alarming consequence of this infestation is the impending risk of colony collapse, a menace that imperils global honey production and the foundation of our planet's pollination system.

Historically, chemical acaricides have been our go-to defense against these mite invaders. However, their effectiveness is waning in the face of resilient mite populations that adapt quicker than we can respond. Additionally, the inadvertent harm inflicted upon our invaluable bee allies by these chemicals is a toll we can no longer afford to pay.

This is where your role becomes paramount. Our laboratory is at the forefront of the battle against varroa mites, leveraging the innate potential of nature itself. While we have previously explored the use of entomopathogenic fungi as a potential solution, they struggled to survive the harsh conditions within beehives.

We are now embarking on an exciting quest to unravel the concealed mysteries of fungal secretions, referred to as secondary metabolites. These enigmatic compounds hold the promise of selective toxicity against varroa mites, potentially negating the need for ideal fungal environments.

As a summer researcher, you will contribute significantly to bee conservation by identifying new sources of these secondary metabolites. You will have the rewarding opportunity to evaluate these compounds for their potential acaricidal properties, potentially uncovering groundbreaking solutions for varroa mite management. Moreover, you will gain hands-on experience in varroa mite management and explore alternative mite species, which serve as valuable models for assessing natural microbial products.

Join us in this essential mission to safeguard our pollinators and secure the future of our ecosystems. Become an integral part of "Advancing Bee Health" and make a tangible impact on bee conservation.

Supervisor: ***Dr. Artemio Mendoza-Mendoza, working with M.Sc. student Alex Maan***

Email: **Artemio.Mendoza@lincoln.ac.nz**

2 Aluminium toxicity in high country soils

Soil acidification is a critical issue which limits grassland and crop production globally. In some soils acidification enhances the mobilization of toxic metals including aluminium (Al), particularly at a pH<5.5. Pastoral high and hill country farmers in New Zealand often face challenges maximising the productivity of their system due to acidic and low nitrogen (N), phosphorus (P) and sulphur (S) fertility soils. Aluminium toxicity is found extensively throughout New Zealand and is an issue associated with acidic soils. Some soil orders are more susceptible to Al toxicity due to higher concentrations of extractable AlCaCl2, which can severely restrict the establishment and growth of legume species. The rooting depth of legumes can be severely affected by subsoil Al toxicity, which occurs in many high and hill country soils. However, the exact nature and drivers of aluminium toxicity in soil are still poorly understood. This scholarship involves field work sampling acid soils in high country, in combination with experimentation on the LU campus examining the nature of these soils. On-farm field sites in central Otago will be visited and sampled, including soils and pasture legumes. Glasshouse and laboratory experiments will be conducted over the summer, involving plant growth measurements.

Supervisor: ***Assoc. Prof. Jim Moir***

Email: **Jim.Moir@lincoln.ac.nz**

3 Animal breeding for improved resilience in hot climates

Lincoln University is collaborating with Livestock Improvement Corporation (LIC) to investigate the effect of dairy cows carrying the SLICK gene on heat and cold tolerance. In this research, calves born in August 2022 and 2023 with or without the SLICK gene will be compared in their growth rate, grazing behaviour and body temperature when exposed to different climatic conditions. The research will be carried out on the university's research dairy farms. Temperature and activity sensors will be attached to calves and visual observations of their behaviour, including respiration rate, will be carried out to determine whether animal genetics affects behaviour of young stock.

Supervisor: ***Dr. Racheal Bryant***

Email: **Racheal.Bryant@lincoln.ac.nz**

4 Balansa clover seed germination responses to different water potential and temperature

Balansa (*Trifolium michelianum*) is an annual clover that provides high yields of quality feed in early spring for lactating stock. In a recent field experiment it failed to germinate from the soil seed bank which may have been due to high soil temperatures, despite high soil moisture. This project will quantify the germination of balansa clover seed from two cultivars, 'Taipan' and 'Viper', in response to different water potentials and temperatures and compare it with other annual clovers, such subterranean clover. The research will help farmers work out ideal conditions for autumn sowing of these important dryland species.

The work will also involve assisting the dryland pasture research at the Field Research Centre, Lincoln University. You will set up and monitor the experiments and collate the data. The results will be incorporated into a 2023 Journal of New Zealand Grasslands manuscript and could be developed into a hydrothermal time model.

Supervisor: ***Prof. Derrick Moot, Dr. Sonya Olykan***

Email: **Derrick.Moot@lincoln.ac.nz**

5 Biases biodiversity and big data

The student will investigate the importance of biodiversity in ecology using large datasets from experiments and analyses all over the world. It is often thought that biodiversity is beneficial to people. However, several groups of researchers overseas have argued that diversity is far less important than we have thought. To better understand this the student will dig through datasets to help develop new analyses for the effects of biodiversity. Willingness to run analyses on computers is needed and some practice is appreciated.

Supervisor: ***Dr. Will Godsoe***

Email: **William.Godsoe@lincoln.ac.nz**

6 Caucasian clover (Cc) seed production and Cc / plantain pasture production

Caucasian clover (Cc) seed has not been available commercially for over ten years. Several farmers planted Cc for seed production in spring 2020 and it is hoped that limited amounts of seed will be available for hill and high country farmers to sow in new pastures in spring 2022. Furthermore, with restrictions on nitrogen fertiliser use on dairy pastures there will be greater emphasis on biological nitrogen fixation by legumes in the dairy industry. Caucasian clover will provide an alternative, more persistent legume, to white clover (wc) in summer moist pastures because its tap root is perennial compared with the short 15 month life of wc tap roots. Also, Cc spreads vegetatively by developing a mass of rhizomes in contrast to white clover's stolons.

Field experimental work during 2023 / 2024 summer will involve monitoring the growth and development of a 2 ha Cc seed crop and measuring its responses to agronomic treatments (fertiliser, herbicides, defoliation, and irrigation). Production of 6 year old Cc / plantain plots will be compared with Cc / grass and pure Cc plots under rotational grazing by sheep. A dairy farm which grazes cows on ryegrass / Cc + wc pastures will be visited to compare the clover contents of pastures of different ages. And, the reproductive growth and development of the three ploidy levels of Caucasian clover will be monitored.

Supervisor: ***Dr. Thomas Maxwell, Dr. Richard Lucas***

Email: **Tom.Maxwell@lincoln.ac.nz**

7 Characterisation of a novel type 2 DNA transposon isolated from Mendel's hawkweed

Apomixis, the ability of plants to produce a clone of the mother, represents a technological approach to disrupt hybrid seed production. The key gene involved in this process if PARTHOGENESIS (PAR), that we have recently identified (Underwood, et al. (2022). A PARTHENOGENESIS allele from apomictic dandelion can induce egg cell division without fertilization in lettuce. Nature Genetics, 54(1), 84–93). The key mutation to this gene, enabling Apomixis, is the insertion of a transposon into the promoter of PAR. Exploration of apomicts in Mendel's hawkweed, dandelion and a related Piosella species, has identified that in each of the 3 cases a different transposon has inserted into the identical location, indicating a very specific integration event. We have identified the parental element in Hawkweed and its sequence indicates that it is a previously underscribed type II DNA transposon of the hAT family that encodes a novel

transposase. The project will involve the introduction of this transposon into the model plant, Nicotiana benthamiana, and testing to see if the transposon is capable of transposition. This will involve the production of transgenic N. benth, PCR and whole genome sequencing to identify transgene insertions and newly mobilised element copies.

Supervisor: ***Assoc. Prof. Chris Winefield***

Email: **Chris.Winefield@lincoln.ac.nz**

8 Collection and curation of entomological specimens for teaching

Your time will be spent collecting, curating, and cataloguing specimens for use in our own teaching labs. You will be expected to collect a taxonomically diverse range of specimens covering as many different insect orders as possible. These will come from a wide variety of different habitats, including terrestrial, freshwater, and this may require you to master several different collecting methods and curatorial techniques, although some of the specimens will need to be preserved in alcohol. You will also make an up-to-date inventory of all of our preserved specimens and slide collection, including their current physical condition, to assist with ongoing management and maintenance of the collection. You will be expected to organise your own collecting trips, so this will require a high level of independence, reasonable physical fitness, and your own transport. A knowledge of the local area and invertebrates would be an advantage, but is not essential.

Supervisor: ***Dr. Cor Vink, Franziska Schmidlin***

Email: **Cor.Vink@lincoln.ac.nz**

9 Collection of entomological specimens for teaching and waterway monitoring

Over the summer, you will catalogue, collect and curate invertebrate specimens for use in our teaching labs. You will also help with on-campus freshwater monitoring. By the end of this project, you will have created an up-to-date inventory of all our adult and larval invertebrate specimens, including their current physical condition, and prepared new specimens for taxa that have been damaged or depleted. You will have collected water quality data and invertebrates from some of the waterways on campus and used this to report on campus water quality.

This project will primarily comprise self-organised field trips and laboratory work. Experience using different terrestrial and aquatic invertebrate collection methods will be helpful, as will knowledge of curational techniques such as pinning insects or preserving invertebrates in ethanol. A knowledge of the local area and its invertebrates would be an advantage but is not essential.

Supervisor: ***Elysia Harcombe, Dr. Jennifer Gillette***

Email: **Elysia.Harcombe@lincoln.ac.nz**

10 Crafting gluten-friendly beer: Strategies for gluten reduction in craft beer

Gluten is a general name that refers to prolamin storage protein fractions found in barley, wheat and rye. Specifically, hordeins, gliadins and secalins, respectively. Hordeins, gliadins and secalins have been identified as inducing Celiac Disease (CD) and for being responsible for Non-Celiac Gluten Sensitivity (NCGS) syndrome.

Barley, wheat and rye are core grains used in the prodcution of Craft Beer. Although the majority of gluten is lost, degraded, or diluted during the beer-making process, in some beers there is enough present to cause medical problems for people with CD or NCGS.

In New Zealand any food or beverage with a gluten level of lower than 20mg gluten/100g food can be classified as low in gluten. Beer in New Zealand cannot be labelled gluten-free as it is made from malted cereals, cereals, or oats.

There are several processing aides and brewing techniques that can be used with certain beers to reduce the gluten content and not compromise the sensory and physio-chemical properties of the beer.

This project will investigate the use and optimisation of processing aides to reduce and manage the gluten levels in Craft Beer in cooperation with a local Christchurch Craft Brewery.

Supervisor: ***Dr. Leo Vanhanen***

Email: **Leo.Vanhanen@lincoln.ac.nz**

11 Decoding nature's secrets: Investigating plant communication with beneficial microbes

Are you passionate about unravelling the mysteries of the natural world? Our stimulating summer research opportunity, "Decoding Nature's Secrets," presents undergraduate students with a distinctive chance to delve deeply into the intriguing realm of plant communication and its symbiotic relationships with beneficial microbes.

This project immerses you in the captivating study of plant-fungus interactions, explicitly focusing on the chemical signals emitted by fungi during their silent dialogue with plants. Beyond this, our research extends to elucidating the impact of these molecules on plant biology, with a particular focus on the intricate transcriptional changes that occur when plants interpret these signals.

As a summer research participant in our laboratory, you will cultivate hands-on expertise in molecular biology. You will learn to develop innovative and efficient techniques for genetically manipulating the roots of legume plants. Imagine working with diverse species like common beans, Lotus japonicus, and Medicago truncatula while ensuring their shoots remain undisturbed. This established approach is widely recognized for shedding light on the captivating world of plant-microbe interactions.

Additionally, you will master the use of state-of-the-art tools such as the Gateway system and confocal microscopy. These tools will enable you to pinpoint plant proteins that respond to Trichoderma and their volatile organic compounds. Over the summer, you will acquire fundamental skills in molecular biology and plant physiology, including the art of cloning plant genes into customized vectors suitable for Agrobacterium rhizogenes. Witness the transformation of these vectors into invaluable insights as they are transferred into the plants.

Do not miss this exceptional opportunity to contribute to pioneering research, acquire invaluable skills, and uncover the enigmatic intricacies of Plant-Microbe interactions. Join us for a transformative summer experience where you will assume a pivotal role in "Decoding Nature's Secrets."

Supervisor: ***Dr. Artemio Mendoza-Mendoza, Prof. John Hampton, Dr. Ulises Esquivel Naranjo***

Email: **Artemio.Mendoza@lincoln.ac.nz**

12 Detecting parasites through autofluorescence

This project will attempt to develop a proof of concept for the visualization of parasite nematodes through the use of autofluorescence. Infection with gastrointestinal parasitic larvae are a major constraint to all grazing livestock. The infective larvae are small, being around 1mm in length and consequently difficult on detect on pasture which leaves limited options for the rapid determination of the number of larvae present on a pasture to estimate either larval challenge, or the size of a population when trying to provide refugia. Recently we have discovered that with the certain wavelengths of light these larvae will display autofluorescence whereby they 'glow' when exposed to light.

Working with colleagues from Canterbury University with expertise in computer vision and machine learning this project will explore the possibility of, and potentially optimize, using autofluorescence to detect and distinguish parasitic nematode larvae with the ultimate goal of developing an in situ real-time method of determining the parasite load on pastures.

Supervisor: ***Dr. Andy Greer***

Email: **Andrew.Greer@lincoln.ac.nz**

13 Developing a bioherbicide for giant buttercup

Giant buttercup is a significant weed of pastoral production, causing an estimated annual productivity loss of NZ$210 million in New Zealand. Current control tools are ineffective due to multiple herbicide resistances in giant buttercup. New control tools such as Sclerotinia sclerotiorum, a plant-pathogenic fungus, have potential as bioherbicide. Whilst natural populations of S. sclerotiorum can be found on giant buttercup populations growing in New Zealand, their concentration is not high enough to provide adequate control. Using augmentative biological control, the amount of inoculum on the weed can be artificially increased. This project aims to evaluate the combination of two new approaches for the delivery of S. sclerotiorum as a bioherbicide for the control of giant buttercup. Studies will be conducted under glasshouse conditions, in preparation for future field application.

Supervisor: ***Prof. Rainer Hofmann, with Dr. Graeme Bourdot (AgResearch), Dr. Laura Villamizar (AgResearch)***

Email: **Rainer.Hofmann@lincoln.ac.nz**

14 Developing metrics to evaluate braided river health

Most of Canterbury's surface water moves through braided rivers. Braided rivers are complicated environments where multiple channels that move over time and space. This makes difficult to determine how mounting human pressures (e.g., nitrogen pollution, gravel extraction, flood bank management) affect the health of braided river ecosystems. Our work over the last year shows that different river channels can house divergent biological communities and nutrient levels. However, it is hard to incorporate these findings into a picture of whole-river health because channels' positions and sizes change rapidly over days, weeks, months, and years. New technology, including in-situ sensors and drones, could provide solutions to this challenge.

In this project the student the student will conduct work on braided rivers across Canterbury, including extended (1-2 week) and overnight field sampling campaigns. This project will involve working as part of a team, as well as capacity to develop independent research ideas. The student will gain key skills in freshwater sampling, managing sensor data, and image processing.

Supervisor: ***Dr. Naomi Wells***

Email: **Naomi.Wells@lincoln.ac.nz**

15 Developing new and non-invasive techniques for managing lizard populations on Banks Peninsula

Banks Peninsula supports two gecko and three skink species, some of which are known to be declining in number. There is a need to survey these species to determine their population status but resourcing this work has become problematic due to the lack of qualified herpetologists, the specific environmental conditions that make it difficult to schedule around other work programs and the lack of non-invasive techniques. In addition, some of the commonly-used trapping techniques such as pitfall trapping are difficult to install in the terrain commonly occupied by lizards and/or risk elevating predation if non-target species such as mice are also coincidentally trapped. Tracking tunnels are useful for monitoring the presence/absence of lizards but it can be difficult to determine which species have been detected. Artificial refugia (AR) have been used successfully to monitor ground-dwelling species but they are subject to over-heating in some situations and therefore pose some risk. Recent developments in the ability to detect multiple lizard species using environmental DNA (eDNA) offer opportunities to study populations in a range of habitats. Collecting the DNA from lizards in a non-invasive

manner is key to this work. Much of the development of this research has been spearheaded by the Southern Lakes Sanctuary in Otago. They have trialled the use of pipes containing filter paper to collect skin samples of threatened skinks which has been successful.

This project will involve undertaking a small-scale study to compare the efficiency of commonly used traditional techniques (AR such as onduline tiles and tracking tunnels) with lizard pipes that collect eDNA. In addition, lizard pipes will be both baited and unbaited to determine whether different lizard species have a preference and whether the method is biasing the results collected. The project involves travel to Misty Peaks Reserve near Akaroa and a reasonable level of fitness to access the field site. The work will be supervised and supported by ecologists from Christchurch City Council in conjunction with Lincoln University. The project provides an excellent opportunity for someone interested in herpetofauna and in post-graduate studies focused on conservation biology. The student working on this project may also assist with field work for the Geeky Geckos monitoring project when time allows.

Supervisor: ***Dr. Jennifer Gillette***

Email: **Jennifer.Gillette@lincoln.ac.nz**

16 Diversity of *Phytophthora* species at Lincoln University

Phytophthora species are known to cause devastating plant diseases including Kauri dieback and potato blight which resulted in the Irish Potato famine during the 1840's. There is a huge diversity within the genus *Phytophthora* with over 170 described species. *Phytophthora* species are naturally dispersed by wind, water and in soils, however, introductions of new species can occur via plant trade and could have implications for local and international plant health. As detection methods improve, our understanding of species composition and diversity is also improving. Within this project the student will collect soil samples from Lincoln University campus to identify *Phytophthora* species present. In addition, methods for *Phytophthora* species baiting will be optimised by trialling plant tissues from different hosts. There will also be the option to test the pathogenicity of hybrid *Phytophthora* species held in the collection at Lincoln University. The student will gain experience in collecting plant and soil samples and general laboratory techniques used in microbiology and plant pathology.

Supervisor: ***Dr. Helen Rees***

Email: **Helen.Rees@lincoln.ac.nz**

17 Dryland pastures – Regen Ag farmlet (two summer scholarships)

A long-term experiment at Lincoln University is examining ‘regenerative’ approaches to agriculture for dryland sheep production. The experimental setup of four 2-ha farmlets compares a regenerative pasture system with a conventional pasture system replicated across soils of two fertility levels. The regenerative pasture system combines a variety of regenerative agriculture practices that include species-rich pastures and high-residual / long-rotation grazing techniques. The conventional pasture system includes lucerne and sub clover/cocksfoot pastures under standard rotational grazing management. The scholar will assist with soil, plant and animal measurements on the experiment.

Supervisor: ***Prof. Derrick Moot, Malcolm Smith, Dr. Alistair Black***

Email: **Derrick.Moot@lincoln.ac.nz**

18 Effectiveness of different settling techniques and fining agents to reduce elemental sulphur levels in grape musts

Elemental sulphur is an important agrichemical primarily used in viticulture to prevent and control powdery mildew. Its use is allowed in organic and biodynamic systems, making it an essential tool for all production methods. However, persistence of sulphur on grapes after harvesting can lead to undesirable outcomes – yeasts can readily reduce elemental sulphur into hydrogen sulphide, a process that results in the formation of a multitude of sulphur-containing compounds, many of which have potent odours and impart a fault to wine. Winemakers can partially resolve the issue by settling the must in white winemaking, which can result in the drastic reduction of sulphur levels. However, there is a marked lack of quantitative data on the effectiveness of different settling methods and fining agents in removing sulphur. The aim of this project is to investigate the removal of sulphur with the settling of musts with and without agents like pectinolytic enzymes, bentonite, and chitosan, and under varied temperature conditions. This information will help winemakers in their decision-making when high sulphur residues are likely to occur. Aspiring scholars with a keen interest in wine or food chemistry, and a passion for the wine industry, will find this project particularly compelling.

Supervisor: ***Dr. Leandro Dias Araujo, Dr. Bin Tian***

Email: **Leandro.Araujo@lincoln.ac.nz**

19 Enhanced rock weathering: CO2 sequestration via silicate weathering

Silicate weathering has regulated Earth's climate over geological time scales. Silicate weathering drives CO2 consumption when carbonic acid derived from dissolution of CO2 in water reacts with silicate minerals to form dissolved inorganic carbon (DIC). This dissolved organic carbon is stored in the ocean for >105 years contributing to ocean alkalinity. Eventually the long-term store of this DIC is in carbonate rocks (e.g. limestone). Climate regulation occurs via a reinforcing effect of CO2-promoted climate warming on silicate weathering rate, which generates the necessary negative feedback. Ultimately silicate weathering will be the mechanism by which the current anthropogenic pulse of CO2 into the atmosphere is attenuated if we do not limit emissions and remove CO2 already emitted. Naturally this process takes in the order of 104 years, which is much to slow to avert the potentially massive disruptions to human civilisation and Earth's ecosystems facing us. Enhancing silicate weathering is one of a handful of carbon dioxide removal technologies promulgated to avert disaster. It relies on speeding up silicate weathering by grinding rocks with reactive silicate minerals up finely and distributing them on agricultural lands. Modelling studies have suggested it has the potential to sequester Gt of carbon if applied widely. The number of modelling and empirical studies is growing rapidly internationally. Yet there are no published studies in New Zealand, which hamstrings us in promoting and monetizing the technology should it be successful: if CO2 drawdown from ERW were quantified and monetized the economic incentives would exist to embed it in land management practices.

This summer scholarship offers the opportunity for a student to support a field and glasshouse-based study of enhanced rock weathering. The student will learn to take soil samples in the field, prepare soil, rock and herbage samples for analyses, conduct data input and analyses and write a scientific report suitable for funding agencies. All going well, they may be contributing to saving the planet.

Supervisor: ***Assoc. Prof. Peter Almond, Assoc. Prof. Jim Moir***

Email: **Peter.Almond@lincoln.ac.nz**

20 Experimental and numerical investigation of soil-water characteristics in pasture soils

Climate change is predicted to increase the risk of drought in many parts of the world. Irrigation efficiency will therefore need to improve to ensure that soil moisture content can provide optimal conditions for plant growth. Sol-water characteristic (SWC) curve provides the fundamental

relationship between soil-matric potential and soil-moisture content which is crucial for efficient water management in pasture soils. The SWC also plays a key role in simulation of dissolved chemical and contaminant transport in pasture sites. Since determination of SWC is experimentally challenging, a wide array of predictive models is available to predict soil-matric potential when soil-moisture content is known.

Based on new and existing SWC data on different pastoral soils in New Zealand, this study will carry out a comparative analysis of widely used SWC parametric models to statistically investigate the best-performing model for New Zealand pasture soils.

Supervisor: ***Dr. Chamindu Deepagoda, Prof. Keith Cameron, Prof. Tim Clough, with Dr. Sam Carrick (Landcare Research)***

Email: **Chamindu.Deepagoda@lincoln.ac.nz**

21 Exploring technologies to accelerate red wine ageing

The aging of wine is a complex process that involves multiple chemical reactions. Traditionally, wine is aged to allow tannins to mellow and various flavours to integrate, producing a smoother, more harmonious wine. However, due to various reasons such as economic pressures or consumer demand, there is interest in accelerating the wine aging process. There are a number of potential technologies proposed to accelerate wine ageing process, e.g. micro-oxygenation, ultrasonication, pulsed electric field. This project is aiming to explore other alternative technologies (e.g. nanobubble) to accelerate the ageing process of red wine. Nanobubble technology has been explored in many applications including froth flotation, surface cleaning without the support of detergent, reducing spoilage microbes for prolonged shelf life, and mineral or biomolecular separation. However, usage of nanobubble technology in food products is still limited and challenging. The potential application of nanobubbles in wine production will be tested, particularly as substitute for current micro oxygenation technology and barrel use for red wine ageing. This project will be ideally suited to a scholar who is interested in the wine/food industry.

Supervisor: ***Dr. Bin Tian, Dr. Leandro Dias Araujo***

Email: **Bin.Tian@lincoln.ac.nz**

22 Find hybrid-free habitats to eco-source seeds for Canterbury restoration plantings

This project is an opportunity to learn more about NZ botany, with a focus on improving the eco-sourcing of seeds for restoration plantings. The Department of Conservation's Motukarara Conservation Nursery collects seeds of wild Canterbury native plants and grows them up to supply restoration planting projects (to learn more, see https://www.doc.govt.nz/our-work/motukarara-conservation-nursery/). To ensure that the right plants are planted in the right places, the nursery needs the seedlings grown from their seeds to be the right species. A problem they are having with this is collecting pure seeds that do not contain hybrids with other species. Hybrids can be with other local native species or, of more concern, with species not native to Canterbury, or to New Zealand, that have been planted nearby. For example, most of the wild "lancewood" seedlings you'll find in city parks are now hybrids between Canterbury lancewood and a North Island species (houpara) that's commonly planted in gardens. NZ ngaio hybridises with the related Australian boobialla, planted in some gardens and parks. Motukarara Nursery no longer collects kowhai seeds from the Port Hill Summit Road because so many North Island kowhai species have been planted there that seed collected from original kowhai trees are now often hybrids. This summer scholarship is to begin an investigation into the extent of hybridisation happening in wild native habitats around greater Christchurch and Lincoln. This will help the Department of Conservation to assess the extent of this problem. In doing so, you will help to locate the best remaining hybrid-free locations in the landscape to gather seeds for restoration projects. The work will be a combination of field work documenting wild hybrids and some time assisting the Motukarara Conservation Nursery. You will also prepare and add voucher specimens of examples of hybrids to the Lincoln University Herbarium, which we are transferring into the new Waimarie building.

Supervisor: ***Dr. Jon Sullivan, with Davena Watkin (Department of Conservation)***

Email: **Jon.Sullivan@lincoln.ac.nz**

23 Geeky geckos Act 2: Using photography and a software package to identify individuals and monitor populations of *Woodworthia brunnea*, the Canterbury gecko

Understanding basic life-history parameters of a population and obtaining accurate estimates of population size are essential to making evidenced-based decisions regarding conservation strategies. Estimating population size and characterizing life-history parameters such as survivorship can be done effectively using mark-recapture studies, which require the ability to identify individual animals. One current best-practice technique for identifying individuals is through use of photography. In the summer of 2022-2023, we developed techniques for using photography and a computer programme called I3S to identify individuals of the Canterbury gecko as part of our ongoing monitoring project on Banks Peninsula. We captured over 150 geckos which are now part of our photographic database, and over 20 of these have been recaptured 1-2 times.

For the summer of 2022-2023, we will continue this project. The project will include 2-3 bouts of field work on Banks Peninsula, checking lizard lodges at some 17 sites and collecting data on all lizards found (skinks and geckos) plus taking pictures of all geckos. Tracking tunnels at each site may also be monitored. Field work hours can be long, and a reasonable degree of fitness and willingness to work in most weather conditions is important. One bout of field work can take anywhere from 4-8 days. In between bouts of field work, the student will curate the gecko database. This includes careful editing of photographs using the protocols in I3S and analysing the photographs to determine whether individuals have been previously captured. Finally, the student will use the database at the end of the project to answer some basic questions about the geckos. The student may also assist with fieldwork for other summer lizard projects. The student needs to be comfortable handling geckos, though no experience is necessary; photography skills and a reasonable ability in working with computer programmes would be useful but not essential. This will be a fun opportunity for someone interested in herpetology and will develop skills that are useful in behavioural, population and conservation ecology.

Supervisor: ***Dr. Jennifer Gillette***

Email: **Jennifer.Gillette@lincoln.ac.nz**

24 Horizon scanning of emerging food safety risks using AI: proof of concept

The rapid development of Artificial Intelligence (AI) and its applications has gained significant attention in recent times. Clearly the ability of AI to process vast amounts of information has significant potential to help explore and resolve complex problems.

Food safety involves the consideration of an extensive range of microbial, chemical, toxicological and other threats, that change over time. National food safety regulators are challenged by the need to identify emerging food safety issues in a fast changing global environment.

We propose to explore the application of AI as an effective tool for this purpose. The project is informed by Prof. Kulasiri's extensive expertise with machine learning and Prof. On's extensive knowledge of food safety issues, and membership of the NZ Food Safety Science and Research Centre.

Supervisor: ***Prof. Stephen On, Prof. Don Kulasiri***

Email: **Stephen.On@lincoln.ac.nz>**

25 Hydrothermal times and the emergence of different brassicas

This research project is aimed at investigating the critical germination process of Brassica crops, including popular fodder and green manure plants like mustard, radish, kale, raphanobrassica, turnips, and fodder rape. This project seeks to understand how temperature and moisture interact to influence the timing of germination in Brassica seeds. Hydrothermal time, a concept combining temperature and moisture data will be used as a key metric for assessing the germination response. This work will aim to create a comprehensive model that predicts the time required for successful germination by subjecting Brassica seeds to various temperature and moisture conditions. This study holds significant agricultural importance as it can provide valuable insights into optimizing crop management practices, enhancing seedling establishment, and ultimately increasing crop yields, contributing to sustainable agriculture practices.

Supervisor: ***Dr. Pieter-Willem Hendriks, Karine Hendriks***

Email: **Pieter-Willem.Hendriks@lincoln.ac.nz**

26 Improving biocontrol of Californian thistle (*Cirsium arvense*)

Californian thistle is a major weed in cropping and pasture systems. In high country pasture systems, this weed is difficult to control as the traditional control methods using herbicide and repeated mowing, are unpractical in this environment. Biological control is another potential control option of Californian thistle. This project aims to improve the inconsistent performance of current biocontrol options for this problematic weed. In a previous project, endophytic isolates have been obtained and some have been shortlisted as potential synergists of the fungal biological control agent, *Puccinia punctiformis*. Also, potential pathogenic fungi have been identified and need to be trialled. The goal of this project is to test the pathogenicity of several endophytic fungal cultures on Californian thistle. This project will also test these cultures in conjunction with the biocontrol fungus *Puccinia punctiformis* to determine if there is a synergistic effect. In this project, the student will learn culturing and fungal identification. The student will also perform detached leaf and pot trials, plus evaluate leaves and plants for disease symptoms. Additionally they will do data entry and potentially some initial statistical analysis.

Supervisor: ***Wendy Kentjens, Dr. Seona Casonato***

Email: **Wendy.Kentjens@lincoln.ac.nz**

27 Invertebrate survey at Yarrs Lagoon

Tārerekautuku Yarrs Lagoon is a freshwater wetland situated on the Ararira / LII River roughly half-way between Lincoln township and Te Waihora Lake Ellesmere. The lagoon was formally an open water body surrounded by low-lying swamp. Land drainage transformed the open water ‘lagoon’ to swamp and marsh wetland habitat. The reserve is now dominated by introduced willow species, mainly grey willow (*Salix cinerea*). The surrounding land is pasture.

However, despite these modifications the wetland supports a high diversity of indigenous species – both flora and fauna, including two remnant stands of Manuka, a rushland site and a number of podocarp species.

https://inaturalist.nz/projects/tarerekautuku-yarrs-lagoon

https://www.selwyn.govt.nz/community/our-natural-environment/community-restoration-projects/trerekautuku-yarrs-lagoon-reserve-management-plan

The Selwyn District Council has begun the process of restoring this significant wetland with the main priority being the removal of the grey

willow. The main technique being used for willow control is to drill and fill (with herbicide) which leaves the trees standing while they die. In some situations where the willows are very small they are being cut and stacked leaving open areas which will be readily colonised by native and exotic plants.

The purpose of the invertebrate survey project is to set baseline invertebrate data for the site. This will enable ongoing monitoring over time to determine changes in species composition as the site reverts to a more native ecosystem. This student will also assist the student conducting the Yarrs Lagoon Vegetation Survey. Much of this project will be spent doing field work at Yarrs Lagoon. While the terrain is flat, it is uneven in places with thick vegetation; the student will need to be comfortable working in fairly dense vegetation and in most weather conditions. Additional support and guidance will be provided by an ecologist with Selwyn District Council.

Supervisor: ***Elysia Harcombe, Dr. Jennifer Gillette***

Email: **Elysia.Harcombe@lincoln.ac.nz**

28 Lamb pH and meat quality: studies on biochemical changes in the high pH meat associated with pre-slaughter farmyards stress

High pH meat is frequently associated with poor shelf-life and eating quality, and pH is a commonly used marker for meat quality. Early detection of high pH lamb is desirable and can improve meat quality control. This project will investigate the biochemical features in the selected meat samples that can be related to meat pH. Those muscles with high pH in the early post-mortem period will be subjected to analyse biomarker molecules at the protein biochemistry lab (the Department of wine, food, and molecular biosciences). The student will learn and carry out key analytical assays which allows measuring the lactic acids and glycogen contents of the tissue, validating the involvement of glycolytic enzymes and calpains (calcium activated proteases) via the immune-detection (western-blotting technique) and electrophoresis techniques. In future, these biomarkers of high pH in the meat could be used for enhancing animal welfare and confirm the relationship between minimising pre-slaughter stress and improving the consistency of meat quality.

Supervisor: ***Dr. Hannah Lee***

Email: **Hannah.Lee@lincoln.ac.nz**

29 Low N farm systems

Meeting the environmental challenges facing agriculture and especially the dairy industry requires investigation into new approaches to farming systems. In this research project the successful applicant will join the Dairy Future: Living Lab team which to investigates the impact of combining N loss mitigations such as plantain, low N fertiliser and grazing management on farm production and profit. The successful applicant will work alongside a technical team to collate information on interactions between cows and pasture and subsequent impacts on milk production and milk composition. The time spent on this summer scholarship can also contribute to the practical work requirement for dairy for those who are completing a B. Ag or B. Ag. Sc.

Supervisor: ***Dr. Racheal Bryant***

Email: **Racheal.Bryant@lincoln.ac.nz**

30 Moss contributions to Aotearoa New Zealand forest fertility

Bioavailable nitrogen produced by nitrogen fixing organisms is a fundamental requirement for terrestrial ecosystem growth. New research shows that some moss species form a symbiosis with cyanobacteria and fix large quantities of atmospheric nitrogen. This suggests that the abundant and diverse mosses in temperate rainforests could actually be helping maintain forest productivity.

In this project the student will work as part of an international research team to measure, for the first time, nitrogen fixation rates by New Zealand mosses. Work will involve two periods of intensive field sampling on the West Coast (one week in November and from 08 – 19 January) as well as laboratory analyses. This is an exciting project that is ideal for someone keen to continue the work into an Honours or MSc research year.

Supervisor: ***Dr. Naomi Wells***

Email: **Naomi.Wells@lincoln.ac.nz**

31 Nitrous oxide emissions from mixed forest-pasture systems

Incorporating tree clusters into grazed pastures could help decrease the carbon footprint of beef and dairy production. Research on these types of mixed land-use agroecosystems has focused on carbon storage in trees and soils. However, it is also likely that soil nitrogen cycling, and thus

potentially emissions of the greenhouse gas nitrous oxide, will be affected by incorporating tree clusters into pastures.

In this project the student will use state-of-the-art in-situ gas analysers to measure differences in nitrous oxide emissions across grass – tree gradients. This will involve field sampling and developing computational methods to quantify ecosystem emissions. The student will gain experience in greenhouse gas sampling and stable isotope approaches. They will work closely with researchers from Lincoln University and Manaaki Whenua Landcare Research.

Supervisor: ***Dr. Naomi Wells, Dr. Charlotte Alster***

Email: **Naomi.Wells@lincoln.ac.nz**

32 Pasture Persistence – determining factors that drive performance of perennial grass cultivars over time

Unravelling the complex interacting biotic and abiotic factors that drive pasture community change is important to develop the appropriate pasture management to improve persistence. Identifying primary driving factors (soil type, summer rainfall, plant N status, population survival mechanisms) and secondary driving factors (invertebrate pest pressure, diseases, weed ingress and high intensity grazing) which act and/or interact to determine productive sown pasture longevity are critical to understanding and therefore managing for pasture persistence. To address this need, and provide the DairyNZ Forage Value Index with persistence trait data for perennial pasture grass species, a long-term pasture persistence trial, consisting of repeated annual sowings, commenced in Canterbury in 2015 and is planned to continue until 2024. This project measures pasture persistence traits of DM yield, botanical composition, grass morphology and density of ten grass cultivars from pasture plots continuously stocked with sheep. The trial site is located at the Ashley Dene Research and Development Station.

Supervisor: ***Dr. Thomas Maxwell***

Email: **Tom.Maxwell@lincoln.ac.nz**

33 Plantain-based pasture to reduce nitrogen losses from grazing dairy systems

Reducing the environmental footprint from the dairy farming sector has increasingly become a research focus in New Zealand. The nitrogen (N) deposited in urine patches of cow grazed perennial ryegrass, and white clover pasture is a significant contributor to on-farm N pollution, due to these swards delivering N in excess of animal requirements. Recently, alternative forages such as plantain (*Plantago lanceolata L.*) has been identified to reduce nitrogen losses. However, testing the implementation of plantain in a farm system is required. Currently, milk production and composition, nitrogen losses and pasture production of dairy cows managed in sub-farms to graze on ryegrass-based pasture containing different proportions of plantain are investigated at Lincoln University Research Dairy Farm (LURDF). Summer scholars are required to help with management of the farmlets, and animal and pasture data collection.

Please note that because the research is based at a dairy farm, the project can contribute towards your practical work requirement for dairy.

Supervisor: ***Dr. Omar Al-Marashdeh***

Email: **Omar.Al-Marashdeh@lincoln.ac.nz**

34 Propagation of select Native New Zealand plants

Vegetative plant propagation of plants can be done with hardwood, semi-hardwood and softwood cuttings. A study looking at different types of cuttings of native New Zealand plants, including mountain snowberry (*Gaultheria depressa*) and ureure, fruit of the Kiekie (*Freycinetia banksii*), will be undertaken. This will include scouting and evaluating native fruiting stands of berries and fruit in and around Canterbury as well as taking cuttings to root in a mistbed at the Lincoln University nursery.

Supervisor: ***Dr. Clive Kaiser, Dr. Pieter Hendriks, Prof. Rainer Hofmann***

Email: **Clive.Kaiser@lincoln.ac.nz**

35 Soil pH and nutrient dynamics of dryland pasture legume species in high country

The productivity of South Island high country is typified by a short, often soil moisture limited growing season, and acid soils (pH < 5.5). Traditionally, white clover has been sown as the key pasture legume, but fails to persist. The use of alternative pasture species, such as deep rooting Lucerne, has been suggested to improve dryland pasture production. However, lucerne is known to be intolerant of acid soil conditions, and related aluminium (Al) toxicity issues. Nutrient and trace element availability is also strongly influenced by soil pH. To offset increased soil acidity, lime must be applied, and where this cannot be done, soils may be too acidic for legumes and productivity declines sharply. This scholarship project will examine a suite of novel pasture legume species grown in acidic / high aluminium soil conditions under field and glasshouse conditions. Field work will be conducted in Central Otago.

Supervisor: ***Assoc. Prof. Jim Moir***

Email: **Jim.Moir@lincoln.ac.nz**

36 Testing plant interactions with their environment

Plants interact with a wide spectrum of environmental variables in nature. This includes abiotic (e.g. availability of water or nutrients, temperature) and biotic factors (e.g. pests and diseases). Examinations of the interactions of these environmental factors with plants provide exciting new research opportunities in plant science. This summer project studies such environmental interactions and how they affect plants. The project will enable the student to learn key skills in plant physiology and provides novel insights for the understanding of plant performance and resilience in a changing environment.

Supervisor: ***Prof. Rainer Hofmann, Dr. Pieter Hendricks***

Email: **Rainer.Hofmann@lincoln.ac.nz**

37 The effect of global warming on soil microbes

In this summer project, student will learn how to run experiments to investigate the effects of climate change. To do this they will use our brand-new temperature gradient block, which allows us to compare the success of microbes at different temperatures. The goal here is to begin understanding how different soil microbes contribute to ecosystem-level temperature responses. This opportunity is ideal for students eager to enhance their lab-based microbiology skills and independent learning.

How soil microbial communities respond to changes in temperature is critical in light of global warming. Small increases in temperature have the potential to elicit enormous changes to microbial activity in soil and plant systems, with consequences for climate-cycle feedbacks and agriculture. Most research focuses on soil microbial responses to temperature at either the population or community levels, failing to connect these disparate scales. Bridging this critical knowledge gap is paramount to develop practical ecological theories with far-reaching implications, such as development of bio-fertilisers and understanding of soil-carbon feedback loops.

Supervisor: ***Dr. Charlotte Alster, Dr. Will Godsoe***

Email: **Charlotte.Alster@lincoln.ac.nz**

38 The minimum shade requirement for livestock

Livestock are often left in an open field. The summer sun causes a heat loading which the animal must dissipate to maintain homeostasis, and that has an energy cost and therefore a feed cost. Shade can alleviate the heat load, but surprisingly the area of shade required by an animal is not clearly quantified. This area is needed to determine the cost of providing shade to balance the feed costs of heat loading. This project will acquire calibrated images from above sheep/deer/cattle with known live weight to determine the area of the animal from above. The actual space requirements will require more due to voluntary personal space requirements and the angle of the sun, but the first step is to determine relationship of liveweight to dorsal planar area.

Supervisor: ***Dr. David Scobie, Dr. Andy Greer***

Email: **David.Scobie@lincoln.ac.nz**

39 The potential of fertilisers as an inhibitor of equine gastrointestinal nematode larval migration

Equine gastrointestinal nematodes (GIN) have been controlled by broad spectrum anthelmintics; however, resistance has been reported to pyrimidines, benzimidazoles and more recently macrocyclic lactones. While fecal egg counts can be used as a tool for strategic drenching, surveys of parasite control practice on Thoroughbred and Standardbred farms in New Zealand and Australia show a reliance on interval rather than strategic drenching of anthelmintics. Although there is no published data it is likely that regular interval drenching with anthelmintics is common across all horse disciplines in New Zealand which will further exacerbate the resistance issue. Thus, the reliance on anthelmintic drenches as the primary source of GIN control will increasingly become an issue. Other methods of interrupting the GIN lifecycle have been the focus of research in other livestock species, one such method has been the use of fertilisers to inhibit egg hatching and larval development.

In this project, the student will evaluate the effect of a range of fertilisers on equine GIN larval migration in vitro. Methods will include larvae collection techniques, running larval migration assays, collecting, analysing, and interpreting data.

Supervisor: ***Jasmine Tanner, Dr. Andy Greer***

Email: **Jasmine.Tanner@lincoln.ac.nz**

40 The potential of *Pseudomonas* and *Trichoderma* sp. on inhibiting *Fusarium* sp., causal agents of root rot of peas

Fusarium root rot is a major disease affecting vegetable production worldwide. Infections can cause yield reductions and economic losses to growers. In New Zealand, pea is regularly grown as a break crop of cereal with both crops regularly affected by *Fusarium* sp.. Pea root rot is associated with three main species: *F. solani, F. avenaceum and F. oxysporum*. However, the chemicals available for use on vegetable crops in New Zealand are limited. This project aims to assess the potential for microbial control of *Fusarium sp*. as a soft alternative control measure to conventional fungicides. Scientists at Plant and Food Research have isolated cold-tolerant strains of *Rhizobium leguminosarum* from root nodules of healthy pea plants to extend the production season of peas as early as winter in New Zealand. It was found that strains of *Pseudomonas* sp. co-existed with *R. leguminosarium* in the nodules on asymptomatic roots and a collection of these strains has been curated. *Trichoderma* sp. are well-known fungal biocontrol agents with known antagonism towards

Fusarium sp.. The aim of this project is to investigate the potential of *Trichoderma* sp. and cold-tolerant strains of *Pseudomonas* sp. to inhibit *Fusarium* sp. associated with root rot of pea using standard microbiological and plant pathological techniques.

Supervisor: ***Dr. Helen Rees (Lincoln University), with Dr. Soonie Chng (Plant and Food Research)***

Email: **Helen.Rees@lincoln.ac.nz**

41 Understanding the role of microbes in resilient soil ecosystems

Healthy resilient soil ecosystems underpin Aotearoa|New Zealand land-based economies. Soils are increasingly vulnerable to land-use change, pathogen/pest invasion, and climate change, all of which degrade soil quality and can reduce their resilience to subsequent stresses. The resilience of soils to these stresses have been shown to be linked to the diversity and structure of soil microbial communities. A key group of beneficial soil microbes are arbuscular mycorrhizal fungi (AMF) which form symbiotic relationships with plant roots, making them a key component of resilient soil ecosystems. In this summer project the student will be involved in research projects investigating how we can create healthy disease-resistant and climate-resilient soils. Specifically the student will be involved in experiments to investigate how land-use shapes AMF and other microbial communities, and how those communities affect the resilience of plants in both agricultural and native ecosystems. These projects sit within the Bioprotection Aotearoa Centre of research excellence, a national research centre dedicated to train the next generation of bioprotection researchers and to deliver world-class research that protects the productive and natural landscapes of Aotearoa New Zealand. This summer scholarship project will enable the student to gain key skills in soil microbial ecology and plant pathology whilst working in a vibrant research group. There may be opportunities to assist with field work in Te kaha, Bay of Plenty.

Supervisor: ***Prof. Eirian Jones, Prof. Amanda Black, working with PhD students Finn Bulman and Alana Thurston***

Email: **Eirian.Jones@lincoln.ac.nz**

42 Understanding the size and pattern of water and nitrogen demand of industrial hemp

Industrial hemp has been identified as a promising crop due to a wide range of possible final products, such as seed, oil, food and fibre for clothing and construction. One of the most advertised advantages of this crop is its low demand for resources, like water and nitrogen. However, there is little evidence of quantification of water use and nitrogen demand by industrial hemp. Therefore, this project aims to quantify and describe the pattern of water and nitrogen uptake of a fibre cultivar of industrial hemp throughout the summer.

Supervisor: ***Dr. Mariana Andreucci***

Email: **Mariana.Andreucci@lincoln.ac.nz**

43 Using a plantain-based pasture to reduce nitrogen losses from sheep grazing systems

Reducing the environmental footprint from the dairy farming sector has increasingly become a research focus in New Zealand. Reducing the environmental impact from the sheep grazing sector is a neglected area. The nitrogen (N) deposited in urine patches of ruminants grazing perennial ryegrass-white clover pasture can be a major contributor to on-farm N pollution, due to these swards delivering N in excess of animal requirements. Recently, alternative forages such as plantain (*Plantago lanceolata L*.) and Italian ryegrass (*Lolium multiflorum L.*) have been identified as having a reduction effect on nitrogen loss. However, testing the implementation of plantain and Italian ryegrass under grazing in farm systems is required. Currently, the liveweight gain and nitrogen losses of breeding ewes and weaned lambs grazing on a plantain-Italian ryegrass-red clover pasture or a perennial ryegrass pasture-white clover pasture are being investigated in a farmlet system at Ashley Dene Research and Development Station. A summer scholar is required to help with management of the farmlet, and to collect animal (liveweight, blood and urine), pasture (production and botanical composition) and soil (N availability) data.

Supervisor: ***Dr. Thomas Maxwell, Dr. Omar Al-Marashdeh***

Email: **Tom.Maxwell@lincoln.ac.nz**

44 Using stabilised mRNAs encoding Wuschel to stimulate the formation of somatic embryos in grapevine and Hop cell cultures

One of the limiting factors to utilising gene editing in plants is the generation of an efficient transformation system. These difficulties are in part due to the often recalcitrant nature of plants to regenerate themselves from cell cultures. Somatic embryogenesis is key for both micro propagation of plants and transformation systems and has been shown recently to be able to be stimulated through the use of Wushel-like transcription factors. The project will focus on delivering stabilised mRNAs encoding Wushel like transcription factors from grapevine and Hops into cell cultures of these plants using biolistic transformation. The resulting somatic embryos are not considered to be transgenic under NZ legislation and regeneration of plants from these cultures will be tested. After establishment of embryogenic cultures we will test the ability to transform grapevine cultures with transgenic reporter genes to establish whether this approach is viable for use in gene-editing for hard to transform horticultural plant species.

Supervisor: ***Assoc. Prof. Chris Winefield***

Email: **Chris.Winefield@lincoln.ac.nz**

45 Vegetation survey at Yarrs Lagoon

Tārerekautuku Yarrs Lagoon is a freshwater wetland situated on the Ararira / LII River roughly half-way between Lincoln township and Te Waihora Lake Ellesmere. The lagoon was formally an open water body surrounded by low-lying swamp. Land drainage transformed the open water ‘lagoon’ to swamp and marsh wetland habitat. The reserve is now dominated by introduced willow species, mainly grey willow (*Salix cinerea*). The surrounding land is pasture.

However, despite these modifications the wetland supports a high diversity of indigenous species – both flora and fauna, including two remnant stands of Manuka, a rushland site and a number of podocarp species.

https://inaturalist.nz/projects/tarerekautuku-yarrs-lagoon

https://www.selwyn.govt.nz/community/our-natural-environment/community-restoration-projects/trerekautuku-yarrs-lagoon-reserve-management-plan

The Selwyn District Council has begun the process of restoring this significant wetland with the main priority being the removal of the grey willow. The main technique being used for willow control is to drill and fill

(with herbicide) which leaves the trees standing while they die. In some situations where the willows are very small they are being cut and stacked leaving open areas which will be readily colonised by native and exotic plants.

The purpose of the vegetation survey project is to set up a monitoring program (vegetation plots, photo points) to determine the response of native regeneration and weed growth to the removal of willows and increased light. This student will also assist the student conducting the Yarrs Lagoon Invertebrate Survey. Much of this project will be spent doing field work at Yarrs Lagoon. While the terrain is flat, it is uneven in places with thick vegetation; the student will need to be comfortable working in fairly dense vegetation and in most weather conditions. Additional support and guidance will be provided by an ecologist with Selwyn District Council.

Supervisor: ***Dr. Jennifer Gillette***

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46 Yield survey and data collation of pastures in New Zealand

For sheep and beef systems, pasture supply is predominantly from unimproved resident pastures. The challenges and costs associated with production land development means these pastures are not commonly renovated and restricted fertiliser input is added. A nationwide survey and mapping of yield of resident and or sown pasture species with and without nutrients can indicate locally (where?) potential yield gaps exist and the quantify the advantages (how much?) of adding nitrogen or legumes in those deficient pastoral systems.

This project aims to pool historical and current data to provide as many datapoints as possible for all agricultural regions of New Zealand through the AgYields National Database (agyields.co.nz). This summer scholarship will involve data mining, documentation, field experimentation, desktop analysis and software skills and to gain knowledge on research, data management and repositories.

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