Summer Scholarships 2021

Bioprotection Aotearoa funded

Sentinel plants for New Zealand's unique virus ecosystems

Currently, 39% of New Zealand's land is "agricultural land" much of which borders native New Zealand ecosystems that harbour important populations of taonga plants. This patchwork creates interfaces where many unique relationships emerge. Previously, movement of viruses has been described from agricultural to native plants causing severe damage to Aotearoa's biodiversity. This growing threat to native ecosystems reveals our lack of understanding of virus ecology: how are viruses shared between plants and how do they evolve in new ecosystems?

We will address this lack of understanding by selecting, and then trialling, a set of sentinel plants that can monitor the prevalence, diversity and movement of plant associated viruses at an agroecological interface. These sentinel plants will be selected on their ease of use and likelihood of virus susceptibility and will include both known exotic model plants and native plants. The sentinel plants will be trialled to test whether previously identified viruses infect them under controlled conditions and at a previously described agroecological interface. This will develop a new biological resource to understand holistically the virus ecology at one of Aotearoa's unique agricultural-native ecological interfaces and help mitigate the potential impacts of pathogen emergence from agricultural land use in New Zealand.

Location: Plant & Food Research, Auckland
Supervisors: Dr Robin MacDiarmid

Identifying genetic barriers to bacteriophage-based biocontrol of plant pathogens

Many environmentally, culturally and economically important plant species in Aotearoa New Zealand are threatened by bacterial pathogens. For example, the *Pseudomonas syringae* pv. actinidiae (Psa) bacterial outbreak threatened our Kiwifruit industry and severely impacted many growers and support industries.

A promising solution for enabling rapid response to future outbreaks is the use of specific viruses, called bacteriophages, to kill bacterial plant pathogens. Most bacteriophages infect only a small subset of bacterial species, which means plant-beneficial bacteria remain unaffected by their use, unlike conventional antibiotic or copper-based treatments.

A major downside of the high specificity of bacteriophages is that identification of the right bacteriophages for use as biocontrols can be challenging and time consuming. One reason for these challenges is that bacteria possess immune systems to protect themselves from bacteriophage infection. In this project, we will expand understanding of the known bacterial immune repertoire and identify what types of bacteriophages can evade bacterial immunity. Knowledge gained will assist future formulation of bacteriophage treatments for existing and new bacterial pathogens in Aotearoa New Zealand.

Location: University of Otago
Supervisors: Dr Simon Jackson

Understanding the genetic means of P. cinnamomi inducing dieback disease

The oomycete *Phytophthora cinnamomi* is a soil-borne parasite responsible for degeneration and root rot diseases which cause significant economic losses worldwide. It is an extremely invasive pathogen found in forestry, horticulture and native plants on every continent. Due to its high temperature tolerance and broad host range, it is considered a pathogen of increasing concern.

This project aims to help protect hosts species of *P. cinnamomi* by identifying genes responsible for its infectious ability and any others that contribute to the resulting plant dieback. This will be achieved through sequencing and genomic analysis, which will be invaluable to the development of targeted countermeasures.

This project is integrated into the bigger framework of plant pathology within Bioprotection Aotearoa, which aims to understand *Phytophthora* pathogens. The student will have the opportunity to work within an active national and international research network. Findings of this project, from both the annotation and generation of genetic data, are expected to be useful in the prevention of wider damage caused by *P. cinnamomi* and the wider range of oomycota.

Location: University of Canterbury
Supervisors: Dr Claudia-Nicole Meisrimler and Dr Sarah Flanagan

Recloaking Papatūānuku: mānuka me te kānuka

This is a fantastic opportunity for a Māori or Pasifika student wanting to gain experience and knowledge through undertaking an internship within an indigenous research programme centred on ethnobotany, indigenous knowledge and invasive weeds and pests with ecosystem ecology. The project's kaupapa is guided by a unique mātauranga Māori and science framework - Te Taiao-a-rangi - which supports a holistic, systems-level approach towards achieving beneficial environmental benefits.

Location: TBA
Supervisors: Dr Nick Waipara, Assoc Prof Amanda Black, Prof Nick Roskruge, Aroha Mead

Lincoln University / industry funded

Bracon variation: Different outcomes within the same species

Interested in ecology, entomology, and ecosystem services? This project will give you experience with all of these and a good balance of indoor and outdoor work.

You will be working alongside a PhD student who is investigating the biocontrol of a major red clover seed pest (red clover casebearer) and helping to develop an understanding of why its main parasitoid (*Bracon variegator*) is currently ineffective. The work that you will do will directly contribute to developing a biocontrol option for this problem that growers are now facing.

You will spend the summer collecting moths from red and white clover fields and bringing them back to the lab. These will then be identified as far as is possible and thereafter used to test the host range of the parasitoid wasp.

The overall aim of the project that you will be contributing to is to develop understanding of why this parasitoid of clover casebearers is very effective in white clover but not so in red clover. This opens up many interesting questions about beneficial insects in agricultural landscapes. In particular you, with others, will consider how a species' behaviour may not only be driven by its identity, but also by the biotic and abiotic components of the agricultural landscape. Such understanding can, in turn, be used to improve the delivery of ecosystem services.

Location: Lincoln University
Supervisors: Prof John Hampton and Dr Stephen Goldson

Modelling stem rust disease in ryegrass cultivars

You will be working over the summer alongside a Postdoctoral Fellow and PGGWrightson Seeds scientists at the Kimihia Research Station, near Lincoln, investigating stem rust development in ryegrass cultivars/genotypes. You will gain experience in disease monitoring in the field, disease assessment in the laboratory, data collation and disease progression modelling.

Location: Kimihia Research Station, Lincoln
Supervisors: Prof John Hampton, Prof Phil Rolston, Dr Nick Davies

Biodiversity, biases and big data

You will help to develop new tests of the causes of biodiversity change in Aotearoa/New Zealand. Focusing on the fate of exotic species soon after their arrival in New Zealand, you will find or simulate data to determine when exotics reduce diversity and when they increase diversity. This will include training in data management and modern analyses of biodiversity. There is scope to do self-directed research.

Location: Lincoln University or remote
Supervisor: Dr Will Godsoe

Jargonauts: is weed science too technical to understand?

The readability of scientific literature is decreasing over time such that even educated members of the public are finding the research impenetrable. In a unique study, this project will use state-of-the-art readability indices to examine how the readability of abstracts in two major international weed science journals, *Weed Research* and *Weed Science*, has changed over the last two decades. Using specialist, but easy-to-use software, the abstracts will be scanned for readability and analysed to examine trends over time and across different topics.

This work can largely be undertaken remotely (e.g., at home) as long as the student has access to a computer and can keep in contact via email and regular Zoom meetings. The project will provide insights into science communication, how to improve the readability of written text as well as basic statistical analysis and data management. In addition, the work will also provide useful background in biosecurity and pest management. It is hoped that this simple analysis could be written up as a publication for one of the journals examined.

Location: Lincoln University or remote
Supervisor: Dist Prof Phillip Hulme