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SCION
FORESTS PRODUCTS INNOVATION

2/12/2016

The Administrator
QEII Technicians' Study Awards
773 Moonshine Road
RD1, PORIRUA, 5381
Phone: (04) 528 0808

Attention: Andrew Hutson

Dear Andrew
Re: Reporting on the completion of Queen Elizabeth II TECHNICIANS' STUDY AWARDS for 2016/2017

In July 2016, I was awarded a study grant as part of the Queen Elizabeth II Technicians' Study Awards programme for the 2016/2017 year. I was awarded the grant to study electrophysiological techniques to facilitate the development of new methods of control and eradication for biosecurity in New Zealand.

Research in electrophysiology is progressive and knowledge gained relates directly back to the research we are starting in New Zealand. The strategic aim of several of the projects in which I work is to ensure a resilient biosecurity system that effectively protects New Zealand against biological risks. Scion's research into new surveillance technologies that actively and rapidly seek and detect pests before populations spread is one new area of research where I contribute to improving our biosecurity system to protect our primary export sectors. Of particular interest to me, is what we can learn from the insect's own sense organs. If we knew more about how an insect senses its surrounding environment, it would enable targeted and environmentally-friendly pest control options for our primary production sectors.

Electrophysiology research and techniques are highly specialised and as such, there are no specific courses of study available. It was my belief that working directly with scientists who currently apply these techniques was the best option for me to broaden my own capabilities. For this reason, I proposed a visit to the Atlantic Forestry Centre in Canada. The scientists of Natural Resources Canada have a world-renowned reputation for pushing the frontiers of science with the provision of 'green' solutions for pest problems.

I travelled to New Brunswick in October 2016 to start 4 weeks of training at the Atlantic Forestry Centre.

Training
Dr. Jon Sweeney leads a diverse research programme that examines the mechanisms of applied chemical ecology and management of invasive forest insects. Dr. Sweeney's research team includes the pivotal research of Dr. Peter Silk, who uses advanced electrophysiological techniques to develop new, sophisticated control methods for pest insects and animals. I trained with scientists under the lead of Dr. Silk, who were actively utilising electrophysiology as a tool within their research.

Training and Benefits
During the 4 weeks at the Atlantic Forestry Research Centre, I worked with numerous biochemists and entomologists. I was exposed to new laboratory techniques, equipment and applications which I can now integrate into my technical skill set and apply them in a New Zealand context. Specifically, I've expanded my technical skills and knowledge in the field of electrophysiology. By working one-on-one with experienced

scientists and technicians who work to elucidate semiochemical, sonic, and other communication signals which enhanced my understanding of the behavioural and chemical ecology of insects. I trained in both electroantennography (testing olfactory responses) and electroretinography (testing vision responses) techniques and was introduced to the testing in bioacoustics. I've developed knowledge of the potential benefits and limitations of these techniques. I was given the time to familiarise myself with laboratory equipment which is required to operate the technologies used in this field of research.

By increasing my knowledge and skill set I have been given the ability to impart knowledge and to offer new ideas that improve the science quality of my team. The knowledge that I've gained will help enhance our entomology research programme and contribute to the delivery of benefits to New Zealand. I intend on sharing and demonstrating knowledge and techniques gained to improve workforce capabilities. Being able to contribute more fully towards research activities has given me greater personal satisfaction and provided a sense of achievement in my role.

Lastly, but of great importance, the primary purpose of the trip was to establish a professional relationship with Dr. Sweeney's research group. I've successfully developed an international network of colleagues who can assist me in my current role. A global support network of like-minded people who can give a different point of view on specific problems in the future; this will lead to greater competence in my job and better research outcomes for New Zealand.

Electrophysiology is an important tool for developing future solutions for pest control and biosecurity in New Zealand. The Queen Elizabeth II Technician's Study Award gave me the chance to broaden my abilities and knowledge, I've now gained more confidence to develop in my career as a technical researcher within the broader science environment.

Regards,

Brooke O'Connor

Appendix

Insects used in Electrophysiology testing:

Asian Long Horn beetle – *Anoplophora glabripennis*
Brown Spruce longhorn beetle - *Tetropium fuscum*
Spruce Budworm – *Choristoneura fumiferana*

Electrophysiology techniques used, were as follows:

Electroantennograms (EAG)

This technique is used to measure the average output of an insect antenna to its brain for a given odour. Abbreviated EAG.

Equipment included:

Experiments conducted using a Syntech EAG Probe containing the pre-amplifier with interchangeable antenna holders. More commonly used was a 'U' shaped probe is plated with gold and setup with an electrically conductive gel. Syntech equipment was used, IDAC2 and a STIMULUS AIR CONTROLLER Type CS-55. All testing was recorded and analysed on GC-EAD 2011 computer program. Only excised antennae were tested in EAG experiments. A small flexible faraday cage was used to mitigate electrical interference to signal reception.

Electroretinograms (ERG)

This technique is used to measure the electrical potentials generated by the retina of the eye when stimulated by light. Abbreviated ERG.

Equipment included:

Experiments were conducted using a range of different LED light wavelengths for future light trapping application. Whole body preparations were used for testing the brown spruce longhorn beetle and spruce bud worm moths. Asian long horn beetles were tested using only the excised head, cut at the prothorax. All appendages were removed to mitigate excess noise with electrical signals to the brain, this included all legs and antennae. Tungsten electrodes were used for signal and reference probes. One micromanipulator was necessary for the signal electrode and the ground was held by a clamp. Electrically conductive gel was used to ensure and maintain electrical circuitry. Syntech IDAC2 was used and GC-EAD 2011 computer program was used to record.

During my time at the Atlantic Forestry centre:

- I was introduced to the methodology of Gas chromatography in the application of Pheromone synthesis of semiochemicals. Most EAG testing involved testing a series of compounds for pheromone synthesis in the Spruce budworm moth.
- I've gained knowledge in rearing methods and techniques for rearing Spruce budworm moth.
- Electrorentinograms (ERG) - Testing of retinal responses to LED wavelength stimulation
- I collaboratively worked with Lucas Roscoe to streamline methodology of setup and probe placement for ERG testing on Asian Longhorn Beetle and Brown spruce longhorn beetle.
- Electroantennograms (EAG) - I'm now familiar with the techniques for measuring responses to stimuli, and the study in the function of olfactory pathways in insects.
- Collaborated in insect trap design, targeting various weevil and Cerambycidae species of beetles

- Lucas and I conducted novel testing on a possible contact pheromone on Asian longhorn beetles excised antennae.
- Chemotaxis experiments - aspect mating pheromone testing in growth chambers, Wind tunnel bioassays and 'Y' tube bioassays. I was briefly involved in a hair pencil study – using Spruce budworm moths.
- Seed lab- introduction and walk through of processes, facilities, and specimens.
- I was introduced to Bioacoustics experiments
- I was introduced to the identification of native and invasive species in AFC labs and in the field, of both insects and plant species.
- I was involved in a field experiment where we were conducting stem injection research of TreeAzin Systemic Insecticide containing azadirachtin for the control of beech leaf mining weevil on American beech trees.
- I was able to source a number of specimens of native and invasive species commonly found in Canada, as a reference collection.

In addition, I was introduced to Sylvar Technologies Inc., who offer environmentally safe and efficacious products for Integrated Pest Management Programs in Canada and in forestry in the USA. This companies main focus is the production and commercialization of baculovirus products. Their aim is to produce products at the disposal of the end-user which will facilitate healthful crops, healthy forests, and a healthy environment. I was introduced to extensive rearing programs which involved but not limited to, Gypsy moth, Cabbage Looper, and the Fall armyworm. This has helped me to identify a wider range of target species, expanding my knowledge in forest and agricultural species of concern in other parts of the world.