



Non-chemical phytosanitary treatment alternatives for export logs

With New Zealand's deadline to use recapture technologies for methyl bromide fumigation two years away, it is timely to review non-chemical alternative phytosanitary treatments for export logs. Heat and irradiation are two non-chemical treatments that were investigated by Scion and collaborators as part of the 2012-2018 market access programme.

The University of Canterbury, in collaboration with Scion, investigated the potential of Joule heating to disinfect export logs of forest insects. Joule heating works by passing a high voltage electrical current through a log. As the current passes through the log, the resistance of the wood causes rapid heating (like an old bar heater) that increases the temperature of the logs above the thermal threshold of the target pests.

High-temperature kiln heating is currently used to treat wood packing and other timber products, but heat has not previously been applied to bulk log exports.

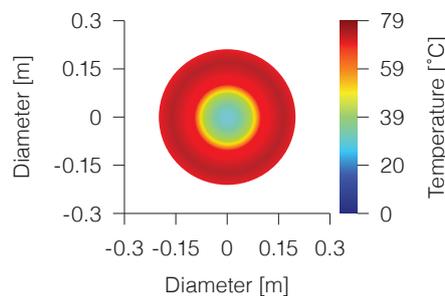


Laboratory rig showing a radiata pine log with temperature sensors inserted after Joule heating treatment.

The University of Canterbury developed sophisticated computer models and equipment to apply and carefully control the Joule heating process.

Scion's role in developing Joule heating was the development of thermal tolerance data for two forest insect species found in New Zealand, the bark beetle *Hylurgus ligniperda* and the wood-boring longhorn beetle *Arhopalus ferus*¹. Egg, larval, pupal, and adult life stages of *H. ligniperda* as well as egg, larval and adult life stages of *A. ferus* were tested. The *A. ferus* pupal stage was not tested because they are unlikely to be present in export logs. *Arhopalus ferus* eggs were found to be the most heat tolerant life stage with a temperature of 55.6°C for 30 minutes required to attain 99.99% mortality with 95% confidence.

In New Zealand, forest insects that may be associated with export radiata pine logs are either bark beetles that feed in the phloem layer at the boundary of the bark and sapwood, or wood-borers that cannot create deep galleries between the time of harvest and export, because of their lengthy life cycles. For example, research² found that *A. ferus*, the species that bores the deepest in logs, took five months to bore to a mean depth of 53.7 mm. Joule heating preferentially heats the outer sapwood faster than the heartwood because of its greater electrical conductivity, which



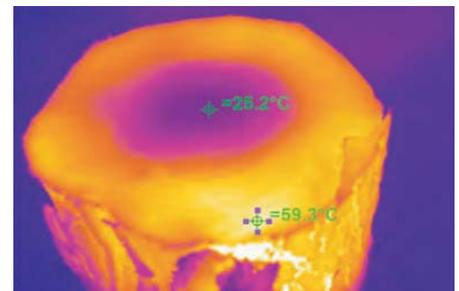
Model-predicted temperature profile of log and thermal image of log 30 minutes after Joule heating treatment.

makes Joule heating ideally suited to effectively disinfect logs of these insects. This method can also be applied to other species, like eucalyptus for veneer³. The University of Canterbury is working with Stakeholders in Methyl Bromide Reduction (STIMBR) to undertake further trials and technical developments before a pilot Joule heating system suitable for phytosanitary applications for log exports is built.

Scion, working with the Environmental Science and Research National Radiation Laboratory to test the tolerance of *H. ligniperda* and *A. ferus* to irradiation, found that doses of 75 to 175 Gray were sufficient to completely sterilise all life-stages⁴. The most severe dose of 175 Gray is significantly lower than the dose levels that are acceptable for other commodities, like fruit and vegetables. The next step is to conduct a techno-economic analysis to assess the practical delivery of irradiation as a phytosanitary treatment for logs.

Research into non-chemical alternative treatments complements the research of our other collaborators at Plant and Food Research who developed efficacy data for ethanedinitrile (EDN), an alternative fumigant to methyl bromide.

Andrew Pugh & Steve Pawson (Scion)



¹ Pawson, S. M., Bader, M. K.-F., Brockerhoff, E. G., Heffernan, B., Kerr, J. K., & O'Connor, B. (2018). Thermal tolerance of phytosanitary timber pests *Hylurgus ligniperda* and *Arhopalus ferus*. *Journal of Pest Science*.
² Romo, C. M., Bader, M. K.-F., & Pawson, S. M. (2018). Quantifying insect wood-boring to improve the effectiveness of phytosanitary treatments. *Entomologia Experimentalis et Applicata*.
³ William J.B.H., Nursultanov, N., van Herel, R., Smart, T. (2018) Joule heating of logs for phytosanitary purposes and timber processing pre-treatment. *Advanced Materials Letters*.
⁴ van Haandel, A., Kerr, J. L., Laban, J., Massart, X., Murray, T. J., O'Connor, B. C., Pawson, S. M., Romo, C. M., & Walker, S. (2017). Tolerance of *Hylurgus ligniperda* (F.) (Coleoptera: Scolytinae) and *Arhopalus ferus* (Mulsant) (Coleoptera: Cerambycidae) to ionising radiation: a comparison with existing generic radiation phytosanitary treatments. *New Zealand Journal of Forestry Science*.

New Zealand Plant Protection Society Annual Conference report

Scion's Forest Protection team was well-represented this year at the 71st New Zealand Plant Protection Society Annual Conference in Nelson, with five staff attending. The NZPPS was founded to foster the exchange of information in the plant protection disciplines, and this was certainly achieved during ten excellent sessions over the three days of the conference. Presentations covered a diverse range of research topics, from risk management treatments for taro in the Pacific Islands, through to weed control, beneficial insects, pasture pests, plant pathology and even work on house-destroying termites in Fiji.

Toni Withers gave a presentation on methods to test the host-range of insect parasitoids, a result of collaboration with B3 members Jacqui Todd from Plant and Food Research, and Barbara Barratt from AgResearch.

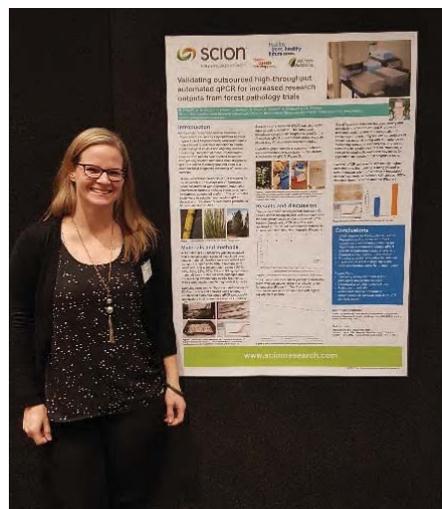
Aymee Lewis presented her research at a conference for the first time, with a poster on



Aymee Lewis with her poster on the phylogeny of *eucalyptus variegated* beetle.

the phylogeny of eucalyptus variegated beetle (*Paropsisterna varicollis*), which showed that specimens from the New Zealand incursion align most closely to populations from Western Australia.

Renelle O'Neill also presented her research at a conference for the first time, with a poster on the validation of automated qPCR for pathogen detection and quantification. Renelle's poster showed that a collaboration with robotic diagnostic services provider, Slipstream Automation, could provide a high-throughput diagnostic alternative for research trials, which previously relied on laborious plating and isolation for pathogen detection. This valuable tool has great potential in increasing the capacity of large research trial analysis, as well as detection sensitivity and analysis timeframes.



Renelle O'Neill with her poster on a high-throughput protocol for the detection of pathogens with qPCR.

Kwasi Adusei-Fosu and Vanessa Cotterill, new members of the Forest Protection team, used the conference as a valuable opportunity to make contact with other researchers in the New Zealand plant protection space. Several contacts were established and valuable insights into current research were gained.

The NZPPS Medal winner this year was Dr. Barbara Barratt from AgResearch, who has had a sterling career studying biological control, and promoting biosafety on the world stage; contributing to New Zealand's position as world leaders when it comes to risk assessment of biological control agents.

Scion were not only well represented in the scientific sessions, but also in the evening entertainment. The team celebrated Toni winning the NZPPS travel award for a long-standing member, which will allow travel to an international conference to promote New Zealand plant protection research. Aymee represented Scion so ably on the dance floor that Toni feels she can now retire from that particular role. All of the attending Forest Protection team members also enthusiastically represented Scion in the annual NZPPS pub quiz and, while failing to take out any large awards, submitted a highly respectable karaoke contribution! The questions were as hard as ever... do you know if you leave Nelson airport and fly directly north, which is the first beach your plane crosses? (Answer below).

Toni Withers, Aymee Lewis, Renelle O'Neill, Vanessa Cotterill & Kwasi Adusei-Fosu (Scion)

Answer: Ninety Mile Beach/Te Oneroa-a-Tōhe