Emerging technologies, new research and development

[1] Globalisation, increasing trade volumes and the complexity of international supply chains are making biosecurity risk management more challenging. Innovative technologies and approaches could assist in this effort. A premium should, however, be given to technologies that are environmentally friendly and not energy resource demanding.

[2] Automating pest detections through the use of innovative technologies could assist with biosecurity screening of sea containers and their cargoes at international ports, building on any existing identification methods. These technologies, if deployed prior to shipping goods, have a potential to improve early detection and avoid high costs associated with eradication and management of pests in the country of import.

[3] In addition to the use of innovative technologies, modifying container designs to minimise collection points for contaminant pests has the potential to reduce pest contamination on the surfaces of sea containers. It should be noted, however, that the typical life span of a container is 12-16 years, so it would take many years before any innovative design would be deployed across the global fleet of containers.

[4] The underside cross members of sea containers, a common location for the interception of pests, provide an ideal opportunity for hitchhiker pests to refuge and contaminants to collect.

[5] Recent detections of khapra beetle in sea containers at the border, in Australia and many parts of the world, have highlighted the need for coordinated innovative approaches to resolve this emerging global issue. Removal of the floorboards in imported contaminated containers, in Australia, has identified large populations of these pests surviving under the floorboards. As khapra beetle can diapause for long periods, they can remain undetected in sea containers for several years. When conditions are favourable, beetle populations can quickly increase and contaminate goods, including "non host" goods held within the container. This experience has identified that traditional risk assessment for identifying higher risk pathways based only on the nature of the cargo and country of origin is not sufficient.

[6] Modification of container designs such as replacing wooden floorboards with metal floors and minimising collection points on the external surfaces could minimise the pest risks associated with the movement of sea containers in the global supply chain. However, such modifications would not address the risks associated with the cargoes themselves.

[7] Australia is currently researching and/or piloting several pest detection and diagnostic systems to automate its pest detection and diagnostic capabilities. These efforts could develop more effective and efficient systems.

[8] Examples of projects and pilots commissioned by the Australian Government include:

(1) **High-resolution camera system**: The use of high-resolution cameras, supported by real-time machine learning software, have been piloted in an Australian port to develop capability for detecting pests on the outside of sea containers in real-time as they are transferred from ship to shore. The pilot validated the practical use of such technologies in automating detection of contaminating pests on the external surfaces of sea containers. Further work is being undertaken to improve the accuracy of the system's capability, with a particular focus on identifying specific hitchhiker pest types, including lower taxa levels.

(2) **Molecular screening**: To facilitate rapid detection of khapra beetles in potentially contaminated sea containers, without having to remove the floorboards, Australia tested and validated the use of molecular screening analysis. As part of this, dust samples collected from sea containers were analysed using Environmental DNA (eDNA) and RNA (eRNA). This proven approach is now being investigated for the detection of other hitchhiker pests.

Other research proposals being considered:

(1) **Container re-design project**: Partnering with a university in Australia and working on the re-design of structural components in sea containers to minimise khapra and other hitchhiker infestations.

To facilitate considerations of possible improvements to container designs to minimise pest contamination, a group of international industry associations have formed a working group. At the time of writing this report, the working group and the Australian container re-design project team are considering collaborative opportunities.

(2) **Molecular detection:** Detecting hitchhiker pests using infrared spectrum analysis of real-time vapours collected from sea containers (without unpacking).
Whilst the above detection and diagnostic technologies are being trialled on arrival in the port of discharge/in the country of import, implementation of these technologies prior to vessel loading would assist in the identification of pest contamination prior to shipping and therefore minimise the risk of pest movements from their origin.