

RESEARCH TO STRENGTHEN AUSTRALIA'S FRUIT FLY SYSTEM WEBINAR – INFORMATION PACKAGE

Due to the ongoing disruptions to face-to-face business from COVID-19 the National Fruit Fly Council (the Council) has commenced a series of webinars to raise awareness of national fruit fly activities. The first of the series, a webinar on the *Research Program for Strengthening Australia's Fruit Fly System* (the Research Program), was held on 17th August 2020. The webinar provided attendees with information on the Australian government's *Smart Fruit Fly Management measure* and the three projects currently funded under the Research Program. This information package summarises the information provided at the webinar.

Agenda

Topic	Presenter
Welcome and overview of session	Christina Cook, Manager, National Fruit Fly Council
Overview of the Smart Fruit Fly Management measure and Strengthening Australia's Fruit Fly System Research Program	Matthew Calverley, Assistant Director, Biosecurity Plant Division, Department of Agriculture, Water and the Environment
Phenology demography and distribution of Australia's fruit flies	Peter Leach, Market Access Focus Team Leader and Senior Principal Entomologist, Queensland Department of Agriculture and Fisheries
A national biocontrol program to manage pest fruit flies in Australia	Paul Cunningham, Research Leader, Invertebrate & Weed Sciences, Agriculture Victoria Research
Efficacy data to support methyl bromide disinfestation treatments against fruit flies	Pauline Wyatt, Principal Research Scientist (Market Access), Horticulture and Forestry Science, Queensland Department of Agriculture and Fisheries

Welcome and overview of session

The Council is hosted by Plant Health Australia and brings together governments, research funders, and a range of horticulture growers and industry representatives. The Council provides a forum for discussion on the national fruit fly system and provides strategic advice on fruit fly policy and RD&E issues to decision makers. With the inability to pursue face-to-face initiatives, the Council has organised a series of webinars which will cover a range of national fruit fly issues. The webinars will be held monthly until the end of 2020.

Overview of the Smart Fruit Fly Management measure

In November 2018, the Australian Government announced the \$16.9 million *Smart Fruit Fly Management measure* (the measure). It acknowledges the importance of managing fruit fly to protect Australia's horticulture industry and supports maintaining a strong, effective and harmonised fruit fly management system.

The measure facilitated the development of the *Intergovernmental Agreement on Strengthening Australia's Fruit Fly Management System* (the IGA). The IGA has been ratified by all Australian governments and outlines the agreed roles, responsibilities, commitments and expectations of all parties to collaboratively strengthen Australia's fruit fly management system.



The Department of Agriculture, Water and the Environment (DAWE) is implementing the measure which supports a wide range of activities that fall into five priority areas:

- **systems capability** – includes the modernisation of Australia’s National Fruit Fly Management Protocols will improve system capability. The protocols include a series of standard operating procedures that provide assurance to international trading partners that Australia’s management of fruit fly is coordinated and consistent.
- **national policy development** – includes the development of a national policy for use of the sterile insect technique (SIT) in fruit fly management. It will outline principles to assist state and territory governments to consistently apply SIT in Australia.
- **technical and scientific advice** – includes a technical feasibility and economic analysis for the eradication of Mediterranean fruit fly from Western Australia is being undertaken by the Australian Bureau of Agricultural and Resource Economics.
- **communication and extension** – includes the promotion of the measure and its achievements to ensure that consistent messaging is provided, and all participants are aware of their shared responsibility.
- **research and development** – includes the establishment of a Research Program to fund research, development and extension activities to enhance the efficiency and effectiveness of fruit fly management activities.

Strengthening Australia’s Fruit Fly System Research Program

The total funding allocated to the Research Program is \$13 million, comprising \$6.5 million from the Commonwealth and \$6.5 million co-contributed by the state and territory governments. DAWE is responsible for the administration and management of the Research Program and is working with all state and territory governments to implement it.

A *Research Roadmap for a National Approach to Fruit Fly Management* (the Research Roadmap) was developed by DAWE to identify research areas that will contribute to strengthening Australia’s fruit fly management system. The Research Roadmap was based on the analysis of scientific literature and prepared in consultation with relevant experts to identify previous research, research currently occurring and emerging research gaps.

The criteria used to prioritise research areas included the following considerations:

- Analysis of scientific literature, and consultation with stakeholders indicating a research gap or need.
- Potential research outcomes align with the intent and purpose of the Agreement.
- Potential research outcomes have potential for national application and broad benefit, including links to other research priorities.
- Potential research should complement but be substantially different to previous or current research activity.

The following research areas were identified in the Research Roadmap:

- Fruit fly phenology and demographic ecology
- Exotic and minor species
- Distribution mapping
- Pathway analysis
- Crop management practices
- Biological control agents
- Fruit fly diagnostic tools
- Post-harvest treatments
- Detection on infected fruit
- Modelling and computational analysis
- Sterile insect techniques
- Fruit fly genetics
- Systems approaches
- Area wide management



To date, three research projects have been commissioned under the Research Program. A summary of the three projects current being undertaken is below.

Research Project	Research Area	Objective
<i>Phenology demography and distribution of Australia's fruit flies</i>	Phenology and demographic ecology Exotic and minor species Distribution mapping Fruit fly diagnostic tools	To broaden our understanding of cyclic and seasonal behaviours in both major and minor fruit fly species in Australia, facilitating the development of accurate models and more effective management of fruit fly nationally.
<i>A national biocontrol program to manage pest fruit flies in Australia</i>	Biological Control Agents	Development of biological control agents such as parasitic wasps, entomopathogenic fungi and nematodes against Queensland fruit fly.
<i>Efficacy data to support methyl bromide disinfestation treatments against fruit flies</i>	Post-Harvest treatments	Optimise and rationalise methyl bromide disinfestation treatments against Queensland fruit fly in a range of grouped commodities to update interstate certification assurance procedures.

Phenology demography and distribution of Australia's fruit flies

Research project

Successful pest management relies on three core pieces of information: where the pests are (distribution), how many there are now and into the future based on seasonal (phenology) and reproductive patterns (demography).

This project will carry out new research, and mine existing data relevant to the phenology, demography and distribution for six of Australia's high priority pest fruit fly species (tephritids):

- *Bactrocera tryoni* (Queensland fruit fly)
- *Bactrocera neohumeralis* (Lesser Queensland fruit fly)
- *Bactrocera aquilonis* (Northern Territory fruit fly)
- *Bactrocera jarvisi* (Jarvis' fruit fly)
- *Zeugodacus cucumis* (Cucumber fruit fly)
- *Dirioxa pornia* (Island fruit fly)

The major activities to be completed under this research project include:

- provide current, confirmed data on the distribution of target species (with a focus on the southern boundaries for the lesser-known species)
- collect and analyse demographic data for all target species (reproductive capacity) on standard diets and a small number of known hosts
- collect accurate data and update host lists for all target species
- collect constant-temperature development-rate data sets
- carry out physiological research on *B. tryoni* to explain non-temperature related patterns in its seasonal phenology
- develop molecular diagnostic tools which can automate the identification of large, multi-species trap catches.



Projected outcomes

By improving strategic knowledge of Australia's pest fruit fly species, projected outcomes for the research project include reduced pest management costs, improved crop yield and quality, improved regional economies and improved food security.

Incorporating modern molecular diagnostic tools will support early detection and accurate rapid identification of fruit fly species, which will improve fruit fly management and control.

Improvements to the national management of fruit fly in horticultural areas will ensure Australia continues to meet domestic and international trade requirements.

Key research components

Phenology and demographic ecology

Phenology and demographic ecology are the study of cyclic and seasonal events in plant and animal populations and is most often measured in relation to current environmental and ecological conditions and the effects of climate change.

A better understanding of fruit fly phenology, population dynamics, behaviour and ecology, and the development of accurate models, will facilitate more effective management of fruit fly nationally.

Exotic and minor species

Understanding biology, life cycle, temperature tolerances, host susceptibility, and attraction to chemical cues, will provide for more effective management of fruit fly.

Additionally, identifying any susceptibility to an incursion of exotic fruit fly species from near neighbours and trading partners is essential to Australia's national preparedness.

Distribution mapping

Improving our knowledge of the distribution of fruit flies within Australia will be beneficial in underpinning existing fruit fly management practices. Whilst the distribution of Queensland fruit fly and Mediterranean fruit fly are relatively well known across Australia, the distribution of minor species is less mapped.

Distribution mapping and greater knowledge of major and minor fruit fly species across Australia may assist and support the development of population forecasts and management frameworks. This will ensure that Australia continues to meet international obligations and importing requirements of our trading partners.

Fruit fly diagnostic tools

Early detection and accurate rapid identification of fruit fly species can improve fruit fly management and control.

Rapid and reliable diagnostic technologies which reduce the resource burden of accurate diagnostics can be applied nationally. Improving fruit fly diagnostic capabilities has a broad benefit to surveillance and response activities, which strengthens Australia's fruit fly management system.

A national biocontrol program to manage pest fruit flies in Australia

Research project

Whilst current fruit fly management practices predominantly target the adult stage of the insect, biological control offers a viable tool for the suppression and management of all fruit fly life stages (egg, larval, pupal and adult).

This research project will explore biocontrol as a strategy to reduce Queensland fruit fly populations in horticultural crops, as well as in other environments in which fruit fly may also be found. The strategies employed will be aimed at targeting all life stages of the Queensland fruit fly and will complement other integrated pest management tools that are currently utilised for fruit fly management.

This project will undertake basic biological research and preliminary field trials to develop and evaluate a strategy for using parasitic insects (parasitoid wasps) and entomopathogenic microorganisms (fungi and nematodes) for sustainable fruit fly control.



Projected outcomes

An effective biocontrol program will facilitate improved management of Queensland fruit fly, with the potential for biocontrol strategies to be incorporated into systems approaches for pest risk management, and local targeted eradication programs.

Incorporation of biocontrol agents into current pest management strategies, would reduce the reliance on traditional insecticide control methods and would employ fruit fly control tools that are more sustainable. Biocontrol strategies that target all fruit fly life stages would enable early population suppression and control, reducing damage to produce.

Improvements to the national management of fruit fly in horticultural areas will ensure Australia continues to meet domestic and international trade requirements.

What is biological control?

Background

Fruit fly control in Australia has predominantly focused on the use of insecticides, trap and kill bait stations, bait sprays and orchard hygiene practices. An additional fruit fly control strategy that is seeing positive results internationally is through biological control agents such as predators, parasitoids and pathogens.

Biological control or biocontrol is a method of controlling pests such as insects, mites, weeds and plant diseases using natural enemies and is an important component of integrated pest management strategies.

Biological control generally involves the introduction of natural enemies into a target pest population or through optimising pest management systems to encourage biocontrol agents that occur naturally within the environment. Once established, the biocontrol agent will then kill or outcompete the target pest species thereby reducing pest populations.

Biocontrol agents

There are three common biocontrol agents used in controlling fruit fly populations and include parasitoids, predators and pathogens.

Parasitoids are organisms whose larvae feed and develop within or on the host organism, killing the host, and free living as an adult. Fruit fly parasitoids develop by laying their eggs in fruit fly eggs or larvae. Parasitoid wasps are currently being used internationally to suppress and control fruit fly populations and will be examined more closely in this project on Queensland fruit fly.

Predators are defined as organisms that eat other organisms. Well known examples of insect predators are lady beetles and lacewings that prey on a number of insect species. Ants are a common predator of fruit fly larvae as they drop from infested fruit to pupate in the soil beneath the tree.

Pathogens including bacteria, fungi, nematodes and viruses can also act as biocontrol agents, infecting and killing a variety of insect species. Entomopathogenic microorganisms (fungi and nematodes) will be examined more closely in this project to demonstrate their efficacy as effective natural enemies of Queensland fruit fly.

Types of biological control

There are three broad types of biological control and include Conservation, Augmentation and Classical.

Natural enemies already occur in all production systems and the **conservation** of biological control agents within a local environment can be simple and cost-effective. Generally, the activity of natural enemies in a local environment can be enhanced through reducing the usage of pesticides or using pesticides that are considered safe for beneficial species.

Augmentation involves the supplemental release of natural enemies at critical times within the season. This allows for adjustments to be made to the cropping system in order to improve the establishment and success of the biocontrol agent.

Classical biocontrol is the introduction of a biocontrol agent that does not naturally occur in the production system where the pest is established.



Efficacy data to support methyl bromide disinfestation treatments against fruit flies

Research Project

Methyl bromide fumigation is a commonly used post-harvest treatment of fruit and fruiting vegetables prior to domestic and international movement of horticultural commodities.

This Research Project will look to optimise and rationalise methyl bromide disinfestation treatments against each life stage for Queensland fruit fly, in a range of grouped horticultural commodities to update interstate certification assurance procedures.

Queensland fruit fly is a major horticultural pest occurring throughout eastern Australia and further research in this area will support domestic and international market access.

This Research Project will start by grouping commodities into three distinct groups based on the relative sorption of methyl bromide. Efficacy data will be then generated on selected key commodities from each sorption group, allowing the development of a methyl bromide dose for each group.

Projected Outcomes

The management of fruit fly nationally would be significantly strengthened if post-harvest methyl bromide fumigation treatments were based on doses that were specific to different commodity groups.

Incorporation of updated and enhanced methyl bromide disinfestation treatment methods will ensure the minimum effective dose of methyl bromide is being used.

Improvements to the national management of fruit fly in horticultural areas will ensure Australia continues to meet domestic and international trade requirements.

What is post-harvest treatment?

Post-harvest treatments of fruit, vegetables and plants is vital in improving marketability and storage life of horticultural commodities, as well as controlling pests and diseases.

Movement of commercial consignments of fruit, vegetables or plants interstate or internationally, often need to undergo phytosanitary treatment in order to be certified as free of pests, diseases and weeds.

Australia has several available post-harvest treatment options for horticulture commodities including fumigation, chemical dipping, cold treatment, heat treatment, atmosphere treatment and irradiation.

Methyl bromide fumigation

Methyl bromide fumigation is one of the most used post-harvest treatments for fruit fly in Australia. Methyl bromide is used as a quarantine and pre-shipment treatment to support international trade for both imports and exports and is also used on horticulture commodities transported domestically.

Methyl bromide is an extremely effective post-harvest treatment option used against a range of insect pests. It is often favoured over other post-harvest treatments due to its low cost, short fumigation times and safety to consumers when compared to other treatments such as chemical dipping.

