Using biocontrol to tackle fruit fly populations in orchards and urban areas

Paul Cunningham, Agriculture Victoria and Tony Clarke, Queensland University of Technology

A national research project led by Agriculture Victoria and co-sponsored by the Department of Agriculture, Water and the Environment (DAWE) and Hort Innovation aims to develop a biocontrol strategy for managing Queensland fruit fly populations in Australia.

The project is exploring the use of Australian parasitoid wasps that specifically target Queensland fruit fly eggs and larvae, and the potential for developing biopesticides as alternatives to chemical insecticides.

Parasitoid wasps: Our friends and the fruit fly's enemy

Parasitoid wasps (parasitoids) are renowned for their ability to hunt down their prey — other insects. The adult parasitoid uses its acute sense of smell like a sniffer dog, locating its 'host' and then laying an egg in or onto it. The parasitoid larva then feeds on its host insect and eventually kills it. Parasitoids are used throughout the world as safe and effective biological control (biocontrol) agents for managing many agricultural pests.

The best known and most widely used parasitoids in biocontrol programs against fruit flies belong to an insect family called Braconidae (braconids). Fruit fly infesting braconids lay their eggs into eggs or larvae concealed within the fruit, where the immature wasp then grows before emerging as a next-generation adult from the pupal case of the now dead fly. Parasitised fruit fly maggots continue feeding, so these wasps are not a pesticide replacement for immediate fruit fly control. However, with field surveys showing that parasitoids can cause more than 30 per cent mortality of fruit fly populations, they should be regarded as a critical component of a fruit fly area-wide Integrated Pest Management (IPM) system.

A newly released parasitoid, *Fopius arisanus*, hunting for fruit fly eggs on an infested guava.
Photo credit: David Madge, Agriculture Victoria

Collaborative research currently underway by Agriculture Victoria and the Queensland University of Technology (QUT) is looking to increase the impact of fruit fly parasitoids on fruit fly populations through two major activities: liberation ("augmentation") and conservation.

Liberating parasitoids in Victoria

In Victoria, the fruit fly parasitoids are almost entirely absent, either because they have not kept up with the southwards spread of Qfly, or because they cannot survive winter. In the first part of the project two parasitoid species, *Fopius arisanus* and *Diachasmimorpha kraussii*, have been collected from the field in South-East Queensland and transported to Victoria.

Both species only attack Queensland fruit fly and other fruit flies of the same family (*tephritids*). Trial liberations of in total 34,000 *F. arisanus* were made into organic orchards and urban areas in summer and early autumn 2021, with recoveries during late autumn showing that the wasps had established and were breeding.

Work this season involves surveys to see if wasps have survived the winter, as well as several more liberations over larger areas. The eventual aim is to have parasitoids available for fruit fly control in temperate Australia, either through permanent establishment or annual commercial release.

Release cages in an apple orchard in the Goulburn Valley. Around 3,000 wasps were released at this site.
Photo credit: Agriculture Victoria

Controlling fruit flies in urban areas

The recent increase in fruit fly populations in regional towns and cities in Victoria is of concern to fruit and vegetable growers across the state.

High fruit fly numbers are a nuisance to home gardeners, but the major concern to industry is that these 'source populations' of flies then disperse out into the orchards, where they cause serious damage to crops and threaten sales on domestic and international markets.

Tackling fruit fly populations in towns and cities could be a major step towards reducing the fruit fly problem in the southern states (Victoria, NSW, and South Australia). Mass releases of parasitoids could also be used together with other strategies such as sterile insect technique (SIT) to help manage fruit fly incursions.

Associate Professor Paul Cunningham, project leader for the national fruit fly biocontrol project, holding a papaya covered with parasitoids, at Agriculture Victoria's mass rearing centre, Tatura SmartFarm, Victoria.
Photo credit: Agriculture Victoria

The mass rearing facility at the Agriculture Victoria Tatura SmartFarm. Photo credit: Agriculture Victoria

Conservation biocontrol

From central NSW north the fruit fly parasitoids are already established in the field. Therefore conservation, rather than liberation, is the key research area. Crop hygiene, the collection and destruction of fallen fruit, is an important fruit fly management tool but it also destroys parasitoids.

Augmentoria, containers in which infested fruit can be placed and only parasitoids (i.e. not fruit flies) can escape, are a tool which overcomes this problem. QUT research has shown that mesh with a 2.00 mm hole size releases >90 per cent of wasps while retaining nearly 100 per cent of fruit flies.

Fifty-percent shade cloth has this hole size, so if used to cover the opening of a rubbish bin, for example, fallen fruit loaded into the bin will release wasps but not flies; thus, crop hygiene is achieved while conserving the parasitoids. Augmentoria can be of any volume, making the technology scalable.

Colin Harris, the researcher leading the QUT component of the natural enemies project, beside an augmentoria at a field demonstration. In this case the augmentoria is a garden compost bin, with a hole cut in the lid and fitted with 50 per cent shade cloth. If loaded with windfall fruit this device will capture emergent fruit flies while releasing the beneficial wasps.

Photo credit: Linda Clarke QUT

Additional parasitoid conservation research is looking at the ability of wild tobacco, a woody-weed that grows along creek lines and paddock edges, to act as a reservoir of *F. arisanus*. The fruit of wild tobacco supports maggots of a non-pest fruit fly, which QUT research has shown also hosts year-round populations of *F. arisanus*.

QUT are currently investigating the distance the wasp will migrate from wild tobacco to a crop, but evidence so far suggests that leaving some self-seeded wild tobacco growing in a gully, or on a farm edge, is an excellent way to conserve the parasitoids between crop cycles.

Acknowledgements

The national fruit fly biocontrol project is enabled through co-investment with Agriculture Victoria; Queensland University of Technology; Western Sydney University; the South Australian Research and Development Institute (SARDI); the Department of Agriculture, Water and the Environment Project 4-EKSH327 (A National Biocontrol Program to *Manage Pest Fruit Flies in Australia*, as part of the ***Strengthening Australia's Fruit Fly System Research Program***); and Hort Innovation Project MT19003 (*Parasitoids for the Management of Fruit Flies in Australia*), a multi-industry strategic levy investment under the Hort Innovation Apple and Pear, Citrus, Raspberry and Blackberry, Strawberry, Summerfruit, Table Grape and Vegetable Funds.

To find out more please contact Associate Professor Paul Cunningham at
paul.cunningham@agriculture.vic.gov.au

AGRICULTURE VICTORIA

QUT Queensland University of Technology

Australian Government
Department of Agriculture, Water and the Environment

Hort Innovation