



Organic Farming: Managing Fruit Fly in Citrus

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This Agnote provides information on Australia's two most important fruit fly pests and describes the management options available to organic producers.

Introduction

Fruit flies are amongst the world's worst pests of fruit. They are present in most countries and attack many types of fruit, as well as fruiting vegetables, ornamentals and some nuts. Feeding by fruit fly larvae (maggots) damages the fruit internally, causing it to ripen prematurely and rot. Up to 100% of fruit may be damaged by fruit fly when infestations are uncontrolled. The presence of fruit fly can also result in the loss of valuable interstate and export markets.

Fruit flies in Australia

While over 80 species of fruit fly are known in Australia, the following two are of major concern:



*Figure 1. Queensland fruit fly (Qfly) - *Bactrocera tryoni* (Photo: NSW Department of Primary Industries)*

This species is native to the humid regions of north-eastern Australia, extending from Queensland into the Northern Territory and New South Wales. Its extensive host range includes many cultivated and wild plants and the adults can fly many kilometres. This allows Qfly to maintain heavy populations in forest and bushland areas and move from there into commercial fruit crops and backyard trees.



*Figure 2. Mediterranean fruit fly (Medfly) - *Ceratitis capitata* (Photo: Department of Agriculture and Food Western Australia)*

Medfly originated in Africa and was introduced to Australia many years ago. It is currently restricted to south west Western Australia. Unlike Qfly, Medfly prefers drier regions. Medfly infests a wide variety of fruits and vegetables and although it can disperse locally in search of suitable egg-laying sites, it is much less mobile than Qfly. Most citrus can be affected by Qfly and Medfly, but citrus is not a preferred host for either pest. The thick skin of citrus can be a deterrent to egg-laying and eggs and larvae can be killed by oil in the citrus rind, especially in immature fruit.

Higher levels of damage to citrus may be expected where the citrus are thin-skinned or already damaged (eg from hail or splitting), or when there are no other suitable fruits available for egg-laying.

See 'State government contacts' for information on fruit fly identification.

Life cycle

Qfly and Medfly are most active from October to May. Some activity will continue in warmer periods during the winter months. Both species overwinter as adult flies in sheltered locations. Medfly also overwinters as eggs or larvae in fruit, or pupae in the soil. Adults of both species become active again in spring and begin laying eggs in mature fruit. For both species, preferred hosts such as stonefruit can support a buildup in populations before citrus fruits become available as egg-laying sites.

The adults can live for a few months and lay hundreds of eggs, several at a time, a few millimetres into the fruit. A Medfly may lay up to 1000 eggs during her life.

Eggs hatch in a few days and the larvae eat through the fruit, growing to about 9mm long when mature. Depending on temperature, this takes one to several weeks for Qfly and two to six weeks for Medfly. Infested fruit often ripen prematurely and drop to the ground. Mature larvae leave the fruit, dropping to the ground and burrowing into the top few centimetres of soil to pupate.

Pupation depth is an important factor for growers who are considering cultivation or livestock as part of their fruit fly management strategy. Results from a range of trials indicate that pupation depth varies with soil texture and moisture content. In moist or dry sand, Medfly pupated within 3cm of the surface. In soil, several other species were observed to burrow to a maximum depth of 7.5cm. When Medfly pupae were buried in compacted soil or moist loose soil, no adults emerged from deeper than 7.5cm, while in dry loose soil, some Medfly adults emerged successfully from as deep as 32cm. Qfly have been noted to rarely pupate deeper than 5cm, with no adults emerging from pupae buried 15cm deep.

The pupal stage lasts one to several weeks for Qfly and two to seven weeks for Medfly. When pupation is complete, the new adults emerge from the soil and take about a week to mate, feed and begin laying eggs.

Adult female Qfly and Medfly need a source of energy and protein before they can mature their eggs. For this, they may feed on nectar, honeydew from sap-sucking insects such as scales and aphids, bird droppings and bacteria.

Qfly generally lays eggs in citrus that is at the 'silver green' stage or more mature, while Medfly prefers fruit that has started to colour. Skin colour may develop prematurely around the egg-laying site (the 'sting') and fungal decay can infect stung fruit under humid conditions. Stung fruit can fall, even if no fruit fly larvae develop.

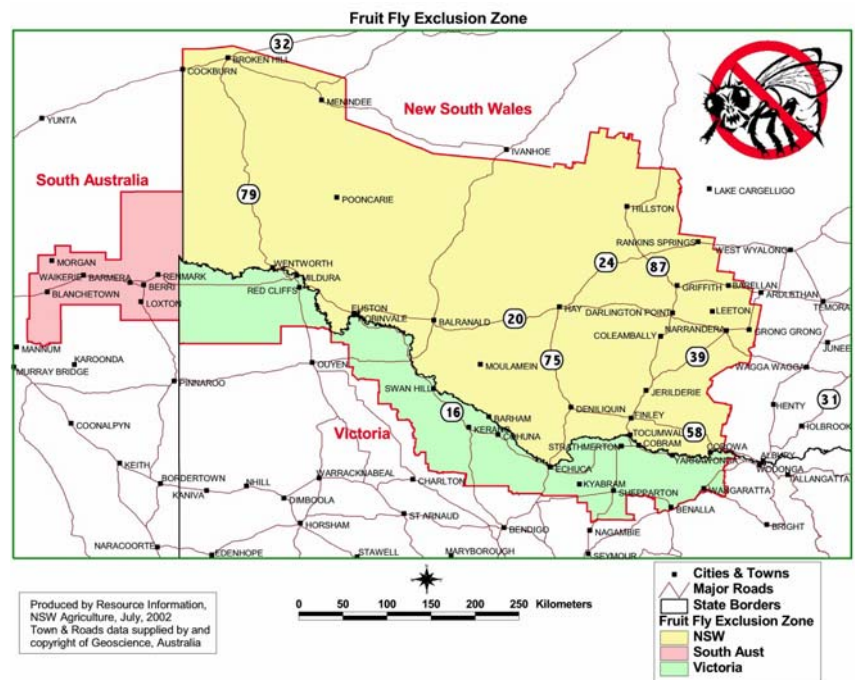
Populations of fruit fly continue to build up through successive generations over the spring and summer months until temperatures drop in autumn.

Fruit fly regions

A region of NSW, Victoria and SA (see following map) has been designated a 'fruit fly exclusion zone' (FFEZ) for the purpose of maintaining access to important markets that are sensitive to fruit flies. The grower's approach to managing fruit fly depends on whether they are within or outside the FFEZ.

Within the FFEZ, state agriculture departments apply quarantine restrictions, operate an intensive fruit fly monitoring program, and when necessary run eradication programs, to maintain the fruit-fly-free status of the zone.

Landholders within the FFEZ must not use sprays or traps for fruit fly unless authorised by a state agriculture department, as they may compromise the effectiveness of the official monitoring program.



The situation outside the FFEZ is summarised in Table 1. Where fruit fly is present, it is up to individual landholders to minimise the risk of damage to their crops.

Management options

The following options for fruit fly management are available to organic producers and should be applied to home garden trees as well as commercial orchards.

Harvest as early as possible.

As the season progresses, fruit fly populations, the attractiveness of fruit to fruit flies and the risk of damage all increase.

Keep tree size manageable. Tall trees are more likely to carry unharvested fruit that can act as infestation sites for fruit flies.



Collect and dispose of fallen fruit

Table 1. Occurrence of fruit fly outside the fruitfly exclusion zone.

State/Region	Fruit fly status	Control by landholders
Western Australia - Kununurra	free	not required
Western Australia - elsewhere	Medfly	permitted
South Australia	free	not required
Victoria - permanent fruit fly zone*	Qfly	permitted
Victoria - elsewhere	free	not required
Tasmania	free	not required
New South Wales	Qfly	permitted
Queensland	Qfly	permitted
Northern Territory -Ti Tree	free	not required
Northern Territory - elsewhere	Qfly	permitted

* Roughly the region east of a line drawn between Wodonga and Paynesville (near Bairnsdale). For a map see www.dpi.vic.gov.au - Agriculture & Food/Plant Standards Branch/Queensland Fruit Fly

Hygiene. Exclude fallen and damaged fruit from the harvest. Collect and destroy all such fruit quickly, eg. by cooking or by sealing in plastic bags in the sun for several days, as larvae can develop successfully in fallen fruit. Remember – do not bury suspect fruit as fruit fly larvae may survive. Inspect trees after harvest, collect any missed fruit and use or destroy it promptly. Remove unwanted and unmanaged fruit trees to reduce the source of breeding sites for fruit fly. This may be especially important for preferred hosts such as stonefruit. **Bait sprays.**

Organically acceptable fruit fly bait containing a food attractant and the insecticide Spinosad (derived from soil bacteria) is available commercially (see ‘Traps, baits & recipes’). The bait is applied as a coarse spot spray, ‘splashed’ onto tree foliage throughout the orchard. The proteins and sugars in the bait attract both male and female Qfly and Medfly. After feeding on the bait, the flies are killed by the insecticide. Bait sprays tend to attract fruit flies from several metres away. They are usually applied to about 25% of all trees in the orchard, eg every second tree in every second row. Baiting should begin when fruit flies are detected (eg in traps) and the fruit is susceptible to egg laying, or at least six weeks before ripening. Fruit flies are most active in the morning so bait sprays will be more effective if applied at that time. The sprays need to be reapplied after rain. Bait spray mixtures may damage the rind of citrus so should be applied to foliage only.

Spinosad-based baits are generally considered more benign than the traditional formulations containing organophosphate insecticides, but they have been reported to kill certain beneficial species such as the red scale parasitoid *Aphytis melinus* and some lacewings. Although the spot-splash method of application should help to minimise any undesirable impact of these baits, growers should remember that the baits are still insecticidal and treat them with appropriate caution.

When using bait sprays, follow the label instructions

Remember, fruit fly bait sprays and traps should not be used within the Fruit Fly Exclusion Zone unless authorised by a state agriculture department.

Trapping.

Traps are generally considered useful for monitoring fruit fly populations rather than controlling them. Recent overseas research however indicates that high densities of traps can remove enough fruit flies to significantly reduce the level of fruit damage. Traps attract fruit flies by using pheromones, food scents or visual cues.

Pheromone traps contain a sex pheromone that attracts male flies. Depending on the trap type, the flies drown in liquid bait, get caught on a sticky layer or are killed by a contact insecticide. In the latter case, the insecticides commonly used are not permitted under organic standards. However, liquid and sticky pheromone traps suitable for use on organic properties are available commercially (see ‘Traps, baits & recipes’).

Food lure traps (wet traps) are also used by some growers. These traps contain a liquid aromatic food attractive to fruit flies (see recipes below). The acidity of the food attractant appears to be important. Fruit flies seem to prefer a pH around 9 and are less attracted to the lure if it becomes more acidic.

Traps need to allow flies to enter easily while excluding rain as much as possible. Clear plastic bottles with several 1cm diameter holes are one option. The holes need to be far enough above the base to allow the bottle to hold a few cm of liquid lure. For safety and maintenance purposes, the bottles should have their original labels removed and be clearly labelled as ‘fruit fly traps’ with the label stating the trap contents, date of placement and name of the person responsible for the trap. The traps should be kept out of the reach of children.

Food lure traps are best placed from 1.5 to 2 metres above the ground in areas where fruit flies rest or feed. This is usually in shady areas within or near the trees being protected. Some traps should also be placed in nearby non-fruiting trees where flies may shelter.

The attractiveness of food lures extends over just a few metres, so these traps should ideally be no more than five or six metres apart.



Figure 4. Home-made fruit fly trap

An alternative trapping approach uses fruit mimics - coloured spheres coated with a sticky gel such as TacGel® or Tanglefoot®. Australian research indicates that for spheres, blue appears to be the best colour for Qfly and yellow for Medfly. Also, it seems that larger spheres (eg 10cm diameter) are more effective than smaller ones. Because the visual range of fruit flies is about 6m, coloured traps should be placed within 6m of the trees being protected.

A disadvantage of sticky traps is that the gel becomes less sticky with age, especially in dusty conditions, and during overseas trials many flies were observed escaping after landing on this type of trap. In addition, sticky sphere traps appear to be much less effective than liquid food lure traps, even when the spheres are baited with an attractant.



Figure 5. Sticky sphere trap for Medfly

Cover sprays.

These are insecticide sprays applied to whole trees to kill various stages of fruit fly. Currently there are no organically-acceptable materials registered for use in Australia as cover sprays against fruit flies.

Physical exclusion.

Individual fruit, branches or whole trees can be protected against fruit fly by bagging, but this is a labour-intensive approach warranted only for very small or valuable crops. In some situations, whole-orchard netting may be justified where protection is required against a number of pests such as fruit fly, lightbrown apple moth and birds, as well as hail.

Biological control.

Newly emerged flies need up to 24 hours for their wings to harden before they can fly, so are prone to predation on the soil surface by birds, ants, bugs and earwigs. Birds including domestic poultry may also contribute to the control of fruit fly larvae in fallen fruit and shallowly buried larvae and pupae. Cultivation would increase the exposure of larvae and pupae to these and other predators, but is not desirable where it would be needed – right under the trees.

Parasitic wasps and nematodes also attack various stages of fruit fly. While all of these natural enemies help to reduce fruit fly numbers, they are very unlikely to provide economic levels of control.

Post-harvest management

Fruit treatment.

There are currently no organically-acceptable post-harvest dips registered for use against fruit fly in citrus in Australia. The only acceptable post-harvest treatment is cold disinfestation, most commonly used for export fruit.

Fruit inspection.

In some situations, untreated organic citrus from fruit fly infested areas can be shipped within or between states if it is inspected, packed and transported according to strict protocols. The protocols may also require that a baiting and trapping program is in place.

Growers should refer to their State Agriculture Departments for details of these post-harvest management options.

Traps, baits & recipes

- **Wild May Fruit Fly Attractant & traps**
(Qfly wet traps)
Tel: 07 3349 5283
email: wildmay@powerup.com.au
<http://www.wildmay.com/>
- **Fly Bye Fruit Fly Lure**
(Qfly wet traps)
Nutri-Tech Solutions
Tel: 07 5472 9900
email: info@nutri-tech.com.au
<http://www.nutri-tech.com.au/>
- **Agrisense fruit fly traps & pheromone lures**
(Qfly & Medfly sticky traps)
Entosol (Australia) P/L
Tel: 02 9758 4552
email: sales@entosol.com.au
<http://www.entosol.com.au/>
- **Eco-Naturalure fruit fly bait spray**
(Qfly & Medfly bait sprays)
Organic Crop Protectants
Tel: 1800 634 204
email: info@ocp.com.au
<http://www.ocp.com.au/>

- **Qfly wet trap lure recipe**

(Tom Wyatt, ABC Qld.)

1 litre water

1 cup brown sugar

1 tablespoon bakers yeast

1 tablespoon Vegemite

1 cup Urine

Mix ingredients and let stand for five days before using. Change every week.

- **Medfly wet trap lure recipe**

(orange ammonia)

280 ml fresh orange juice

25g ammonium carbonate

1g potassium sorbate

600ml water

Mix ingredients then dilute in the ratio of one part to 10 parts of water.

State government contacts

Use the following contacts for information on fruit fly identification or to report suspected fruit flies in fruit fly free districts:

- **New South Wales** – your nearest DPI office or 1800 084 881
- **Northern Territory** – your nearest DPIFM office or 08 8999 5511
- **Queensland** – Department of Primary Industries and Fisheries, Tel: 13 25 23
- **South Australia** – the Fruit Fly Hotline, Tel: 1300 666 010
- **Tasmania** – Department of Primary Industries and Water, Quarantine Centre, Tel: 03 6233 3352 or email Quarantine.Enquiries@dpiw.tas.gov.au
- **Victoria** – Department of Primary Industries, Plant Standards Tel: 1800 084 881 or email plant.standards@dpi.vic.gov.au.
- **Western Australia** – Department of Agriculture and Food, Pest and Disease Information Service, Tel: 1800 084 881 or email info@agric.wa.gov.au

References

Botha J, Hardie D, Power G (2000) Queensland fruit fly – Exotic threat to Western Australia. Factsheet 43/2000. Agriculture Western Australia.

Broughton S (2004) Control of Mediterranean fruit fly (Medfly) in backyards. Gardennote 24. Department of Agriculture Western Australia.

Dominiak B (2007) Queensland fruit fly. Primefact 520. NSW Department of Primary Industries.

Drew RAI, Prokopy RJ, Romig MC (2003) Attraction of fruit flies of the genus *Bactrocera* to colored mimics of host fruit. Entomologia Experimentalis et Applicata 107:39–45.

Hardy S (2005) Queensland fruit fly: information and management. Citrus fact sheet. NSW Department of Primary Industries.

Heaven D (2006) Fruit flies. Fact sheet 21/77/06. Primary Industries and Resources South Australia.

Messing R (1999) Managing fruit flies on farms in Hawaii. Insect Pests Brief IP-4. Cooperative Extension Service, College of Tropical Agriculture & Human Resources, University of Hawaii.

Michaud JP (2003) Toxicity of fruit fly baits to beneficial insects in citrus. Journal of Insect Science. 3:8.

Smith D, Beattie GAC, Broadley R (1997) Citrus pests and their natural enemies – Integrated pest management in Australia. Queensland Department of Primary Industries.

Useful contacts

Australian Quarantine and Inspection Service (AQIS) Organic Program

For information on certification organisations, the 'National Standard for Organic and Biodynamic Produce' and export requirements for organic produce.

Tel: (02) 6272 3928

Email: organic@aqis.gov.au

Internet: <http://www.daff.gov.au/aqis/export/organic-bio-dynamic>

Organic Federation of Australia (OFA)

Australia's peak organic industry organisation.

P.O.Box 369

Bellingen NSW 2454

Tel: 1300 657435

Email: info@ofa.org.au

Internet: www.ofa.org.au

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