



# SOUTH PACIFIC COMMISSION

## MANGO FRUIT FLY



Fig. 1: Adult female of mango fruit fly (*Bactrocera frauenfeldi*).



Mango fruit fly (*Bactrocera frauenfeldi*) (Diptera: Tephritidae) is a pest of fleshy fruits and is present in Papua New Guinea (PNG), Solomon Islands, Palau, Federated States of Micronesia (FSM), Marshall Islands, Nauru, the Gilbert Islands of Kiribati and, since 1974, in northern Queensland. Throughout its geographic range, it is a very common fruit fly species. It is present even on the most remote atolls. On some islands, particularly in FSM, it is extremely abundant.

#### DESCRIPTION AND LIFE CYCLE

The adult female fly (Fig 1) lays her eggs in batches under the skin of fruits with her needle-like ovipositor (egg-laying tube at tip of abdomen, Fig. 2). One mango fruit fly female can lay an average of at least 25 eggs in 24 hours. The egg is creamy-white, spindle-shaped and measures 1 mm long (Fig 2). As the female fly punctures the fruit with her ovipositor, bacteria on



Fig. 2: Female ovipositing & egg mass.

the fruit surface are pushed into the fruit. These bacteria cause fruit decay, providing a medium in which the larvae feed. Eggs hatch in about two days to produce larvae. The larva is a creamy-white maggot (Fig 3), that feeds on the fruit's flesh that has already started to decay due to the bacteria (Fig 4). The larval feeding results in inedible fruits and, in some cases, premature fall of the fruit. The larva grows in size by shedding its skin (moulting) twice, defining three larval stages (instars). The larva is fully grown 10.5 days after the egg was laid and measures 10 mm long and 2 mm wide. At that point, the larva leaves the fruit, drops on the ground,

burrows for a short distance into the soil or debris and transforms itself into a brown puparium, a hard case in which the larva becomes an adult (Fig 5).

After 11 days, the adult emerges from the puparium and digs its way out of the soil or debris.

The adult mango fruit fly (Fig 1) is predominantly black and it is about the size of a house fly. It is readily distinguishable from other fruit flies by the pattern of dark bands on its wing: by the very pale, narrow band along wing margin (labelled "a" on Fig 1) and the presence of a dark band across the wing (b). It must not be confused with similar species, such as *B. caledonensis* (New Caledonia), *B. trilineola* (Vanuatu) and *B. parafrasfeldi* (Northern Territory in Australia). Females mate within 7–10 days of emergence and are ready to lay eggs when they become mature, two to three weeks after emergence. For eggs to be viable, the female must feed on sources of protein which, in most cases, are bacteria on the leaf and fruit surfaces in the host tree.



Fig. 3: Larva inside a Surinam cherry.



Fig. 4: Cross-section of a guava damaged by larvae of mango fruit fly.



Fig. 5: Puparia.

#### HOSTS AND DAMAGE

Throughout its range, mango fruit fly is known from 61 fruit species, belonging to 37 plant genera and 23 plant families. In FSM, the main hosts (and the mean percentage of ripe fruits infested) are guavas (31–91%), tropical almonds (*Terminalia catappa*) (69%), Surinam cherry (*Eugenia uniflora*) (61%), avocados (57%), Polynesian chestnuts (*Inocarpus fagifer*) (56%), mountain, water, Java and rose apples (*Syzygium spp*) (38–51%), breadfruits (37%), soursops (28%), pond apples (*Annona glabra*) (26%), tangerines (20%), carambolas (18%), mangoes (8%) and oranges (4%).

#### CULTURAL CONTROL

Crop sanitation is simple and very effective. It consists of regularly destroying fallen fruits and overripe or damaged fruits in trees, that are breeding grounds for fruit flies. The collected fruits may be either burnt, fed to pigs or placed in a tightly closed plastic bag in the sun for several days. Fruits may be buried, but must be covered by at least 50 cm of soil. Fruits harvested at an early stage of maturity are less likely to be infested. In FSM, less than two percent of tangerines are infested when harvested at the mature green stage.

#### BIOLOGICAL CONTROL

In PNG and Solomon Islands, several species of parasitoid wasps attack the

larval stage of mango fruit fly. These include *Diachasmimorpha longicaudata*, *Diachasmimorpha sp*, *Fopius deeralensis*, *Psytalia fijiensis* and *Opius sp*, but levels of parasitism, less than five percent, are too low to achieve control. In FSM, parasitoids are entirely absent. Attempts to control fruit flies by introducing exotic parasitoids have resulted in at most their establishment, but no significant reduction in levels of damage. Parasitoids, nevertheless, contribute to the regulation of populations and must therefore be preserved by using field control methods that follow principles of Integrated Pest Management.

#### PROTEIN BAIT SPRAYING

Protein bait spraying is an effective fruit fly control method. It consists of spraying a solution of protein and insecticide in water over a small area of leaves on each tree. Sexually immature and some mature female flies, in need of a protein meal to produce viable eggs, are attracted to the bait, feed on it and are killed by the insecticide. One source of protein is Mauri's Pinnacle Protein Insect Lure (MPPIL), manufactured in Toowoomba, Australia. Bait spraying is environmentally friendly because it specifically targets fruit flies, a minimal amount of insecticide is used, the fruits themselves are not sprayed and natural enemies are conserved because most of the foliage is not sprayed. The following formulation is recommended:

50 ml of MPPIL concentrate  
4 ml of Malathion 50% emulsifiable concentrate made up to one litre with water.

The bait solution is sprayed at a rate of 50–100 ml on the undersurface of one square metre of leaves on each tree. Every trees in and surrounding the orchard must be sprayed, even those not bearing fruits or not fruit fly hosts. Sprays are repeated every seven days, starting one month before fruits start maturing. In very rainy areas, the spray interval should be decreased to every five days.



Fig. 6: Modified Steiner trap

## QUARANTINE SURVEILLANCE

Modified Steiner traps (Fig 6) are used for quarantine surveillance for fruit flies. They are used as an early warning system to detect new introductions of exotic fruit flies. They are also used to carry out surveys of existing species and to monitor the seasonal abundance of these species of fruit flies. Chemical lures that attract male fruit flies, with a small amount of insecticide to kill the flies, are placed on cotton dental wicks in traps. Cue lure and methyl eugenol are the two most commonly used attractants. Mango fruit fly, melon fly and Queensland fruit fly are attracted to cue lure. Methyl eugenol attracts, among others, Oriental fruit fly and papaya fruit fly. Traps are charged with a mixture of four parts of lure and one part of Malathion 50% emulsifiable concentrate. The two lures must be used in separate traps. Traps are examined and emptied every two weeks and the lure is renewed every three months using a dropper. For quarantine surveillance programmes, cue lure and methyl eugenol traps are installed in areas with high risk for exotic fly introductions, such as urban and suburban areas, ports of entry, dumps, commercial farming and tourist areas.

## COVER SPRAYS

The most widely used insecticides as cover sprays against fruit flies are dimethoate (Rogor) and fenthion (Lebaycid). This approach is not recommended for Pacific Islands, which have very sensitive ecosystems. Cover sprays kill beneficial insects, and leave unwanted residues inside fruits.

## POST-HARVEST DISINFESTATION

The aim is to kill all eggs and larvae of fruit flies present inside harvested fruits to guarantee quarantine security for the importing country. Fumigation is the classical method, but is becoming progressively out of use due to ethylene dibromide being banned, as it is a carcinogen, and the likely banning of methyl bromide as it is an ozone depleter. Heat treatment, by blowing hot air or vapour heat over the fruits in a special chamber or dipping fruits in hot water, kills all immature stages of fruit flies and may allow export of treated fruits. Hot forced-air units are available in Fiji, Tonga and Cook Islands and these countries now export fresh fruits to New Zealand. This treatment is not yet available against mango fruit fly because research is still in progress to determine the heat tolerances of eggs and larvae.

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