This data sheet covers only the non-European fruit flies (Diptera: Tephritidae \[= \text{Trypetidae}\]). It does not cover the many gall-forming and other species that feed in the vegetative parts of plants. The fruit flies presenting a phytosanitary risk to EPPO countries fall into two principal groups: cool temperate species mostly capable of diapausing and usually univoltine, and warm temperate or tropical species mostly capable of continuous breeding apparently without diapause. This data sheet presents information on \textit{Rhagoletis pomonella} and \textit{Dacus tryoni} as representatives of the first and second groups respectively, together with references to other species where appropriate.

The EPPO A2 list includes the Mediterranean fruit fly (\textit{Ceratitis capitata} [Wied.]), for which a separate EPPO data sheet is published.

### Scientific and Common Names

Although the generic names have sometimes changed, the nomenclature in this group has, with exceptions, remained remarkably stable.

#### Cool-temperate Species (Group 1)

There are more than 20 species in North America of which the following are the more economic species:

- \textit{Rhagoletis pomonella} (Walsh) - Apple maggot
- \textit{Rhagoletis cingulata} (Lw.) - North American cherry fruit fly
- \textit{Rhagoletis indifferens} (Curr.) - Western cherry fruit fly
- \textit{Rhagoletis fausta} (O.-S.) - Black cherry fruit fly
- \textit{Rhagoletis mendax} Curr. - Blueberry maggot
- \textit{Rhagoletis ribicola} Doane - Dark currant fly
- \textit{Rhagoletis completa} Cress. - Walnut husk flies
- \textit{Rhagoletis suavis} (Lw.) - Currant fruit fly, yellow currant fly,
- \textit{Rhacoclaena japonica} Ito - Japanese cherry fruit fly

#### Warm-temperate and Tropical Species (Group 2)

This is a large group. The genera \textit{Anastrepha} and \textit{Dacus} contain several hundred species which feed on tropical fruits but only a few can be mentioned here:

- \textit{Dacus (= Strumeta) tryoni} (Frogg.) - Queensland fruit fly
- \textit{Anastrepha fraterculus} (Wied.) - South American fruit fly
- \textit{Anastrepha ludens} (Lw.) - Mexican fruit fly
- \textit{Ceratitis (= Pierandrus) rosa} Karsch - Natal fruit fly
**Dacus ciliatus Lw.**
(= *D. brevistylus* Bez.)
Lesser pumpkin fly

**Dacus cucurbitae** Coq.
Melon fly

**Dacus dorsalis** Hend.
Oriental fruit fly

**Dacus tsuneonis** Miyake
(= *Tetracoccus citri* [Chen])
Japanese orange fly

**Dacus zonatus** Saund.
Peach fruit fly of India

**Pardalaspis cyanescens** Bez.

**Pardalaspis quinaria** Bez.
Rhodesian fruit fly

**Geographical Distribution** (13, 15)

**North America:**

*Rhagoletis pomonella* (most important as a pest in the north-eastern United States and south-eastern Canada, but found south to northern Florida and west to Oregon. It also occurs in Mexico).

*R. cingulata* (eastern Canada and USA)

*R. indifferentes* (western Canada and USA)

*R. fausta* (Canada and USA - separate populations in east and west)

*R. mendax* (eastern Canada and USA)

*R. ribicola* (western Canada and USA)

*R. completa* (western USA)

*R. suavis* (eastern USA)

*Epochra canadensis* (Canada, USA - widespread)

*Anastrepha ludens* (Mexico, migrates to Rio Grande, USA)

**Central and South America:**

*A. fraterculus* (widespread)

*A. ludens* (Costa Rica and Guatemala)

**Africa:**

*Ceratitis rosa* (widespread in south and east, Mauritius)

*Dacus ciliatus* (widespread south of Sahara, Egypt)

*D. cucurbitae* (scattered - Egypt, Mombasa area, Mauritius and Réunion)

*D. zonatus* (Mauritius)

*Pardalaspis cyanescens* (Malagasy Republic, Mauritius and Réunion)

*P. quinaria* (scattered from South Africa to Sudan)

**Indo-Pacific area:**

*Dacus tryoni* (eastern Australia and some Pacific islands)

*Rhagoletis japonica* (northern Japan)

*D. ciliatus* (Arabia and Indian region)

*D. cucurbitae* (from Afghanistan through India, and south-east Asia to Japan)

*D. dorsalis* (widespread through India, Indonesia and south-east Asia)

*D. tsuneonis* (southern Japan and south-western China)

*D. zonatus* (Indian region)

*Pardalaspis quinaria* (Aden)
Adult male and female of *Rhegoletis pomonella*  
(Courtesy E.H. Glass, New York State Agricultural Experiment Station, USA).

Adult *Rhegoletis pomonella*, close-up view  
(British Crown Copyright; courtesy Harpenden Laboratory, Harpenden, GB)
Apple injured by apple maggot
(Courtesy E.H. Glass, New York State Agricultural Experiment Station, USA).

Apple maggot damage to apple
(Courtesy E.H. Glass, New York State Agricultural Experiment Station, USA).
Principal Hosts (13, 14, 18, 29, 35, 37)

Group 1

*Rhagoletis pomonella*: fruits of *Malus* spp. (apple, crab apple) and *Crataegus* spp. (hawthorns) are the main hosts but it is also reported from the fruits of *Prunus cerasus* (sour cherry), *P. avium* (sweet cherry), *P. armeniaca* (apricot), *P. angustifolia*, *Pyrus communis* (pear), *Aronia arbutifolia*, and *Rosa rugosa*. It appears to be an adaptable species and likely to extend its host range.

The larvae of *Rhagoletis cingulata*, *R. indifferens*, *R. fausta* and *Rhacochlaena japonica* feed in the fruits of cherries. Those of *Rhagoletis ribicola* and *Epocha canadensis* feed in fruits of *Ribes* spp. and those of *R. completa* and *R. suavis* in the mesocarp of *Juglans* spp. Larvae of *R. completa* have also been found in peaches.

Group 2

Most of the species in this group are highly polyphagous. Hosts include most pome and stone fruits, citrus, grape, *Rubus* and many tropical fruits. Vegetables with fleshy fruits may also be hosts, including cucurbits, solanaceous plants and some legumes. Each species has a different range of preferred hosts though some are so similar that they may be ecological homologues (18). Host lists are however difficult to interpret because one species may displace another sympatric species from the latter’s preferred host (14). The following crop groups include major hosts of the species listed:

| Citrus | *Anastrepha fraterculus, A. ludens, C. rosa, D. dorsalis, D. tryoni, D. tsuneonis, P. quinaria* |
| Temperate pome fruits | *A. fraterculus, C. rosa, D. dorsalis, D. tryoni* |
| Temperate stone fruits | *A. fraterculus, C. rosa, D. dorsalis, D. tryoni, D. zonatus, P. quinaria* |
| Cucurbits | *D. ciliatus, D. cucurbitae, P. cyanescens* |
| Solanaceous plants | *D. cucurbitae, P. cyanescens* |

Biology

*Group 1 (12, 26)*

*Rhagoletis pomonella* overwinters as a puparium in the soil. The emergence of the flies may be spread over 8 weeks. Accumulated temperatures have been used to predict emergence dates in Canada and the USA (30, 36). In Nova Scotia, the first flies usually appear in early July and peak numbers are reached in late July or early August. Part of the population spends two winters in the puparium: these flies emerge late, contributing to the prolonged emergence period. The eggs are laid singly in punctures made in the skin of the apple by the ovipositor of the female. Eggs hatch in 3 to 5 days at 25°C in the laboratory, and in 5 to 10 days in the field. The larvae bore through the flesh of the apple and many larvae can develop in one fruit. Larvae develop slowly in green fruit and usually complete their development after the fruit has fallen from the tree. The puparia are formed 5-7 cm down in the soil. There is a partial second generation of flies in late autumn from larvae developing in apples that mature very early.

The life cycles of the other species in *Group 1* are very similar to those of *R. pomonella* though their emergence periods are usually shorter. The emergence of *R. indifferens* in Canada has been estimated from accumulated temperatures (1).

*Group 2 (3-10, 27, 28)*

*Dacus tryoni* appears to overwinter as an adult in the southern parts of its range. No diapause is recorded. Adults are recorded as surviving for up to 11 months at 22-24°C with an average life of 6 months. Prolonged storage at 10-13°C reduced the average adult
life to less than 1 month. Adults were killed by exposure to freezing temperatures, but considerable ability to acclimatise has also been shown. In Australia strains adapted to the cooler climate of Victoria have been detected (23).

The females start laying about two weeks after emerging from the pupae. The female punctures the fruit with her ovipositor and excavates an « egg chamber » in which up to 12 eggs are laid. The eggs hatch in 2-3 days in warm weather. The larvae feed in the flesh and as many as 40 larvae have been found in one peach. Larval development in Jonathan apples took 18 days at 18°C, 12 days at 24°C and 9 days at 29°C. The period is usually shorter in soft-fleshed fruits but may be lengthened by overcrowding. The larvae leave the fruit when fully grown and pupate in the soil. The pupal stage lasts from 9 days at 29°C to 26 days at 18°C but may be much longer at lower temperatures. The general ecology of D. tryoni in an orchard in New South Wales is reviewed in (10).

The biology of the other species in this group is generally similar to that of D. tryoni, though D. tsuneensis overwinters as pupae and is therefore intermediate between the two groups. The larvae of species such as D. cucurbitae may also feed in tender parts of the plant other than fruit. Those of Ceratitis rosa are able to feed in less ripe, harder fruits than those of Ceratitis capitata.

Economic Importance

**Group 1 (17, 26)**

*Rhagoletis pomonella* is rated as a major pest of apple in North America, second only to codling moth. There are two types of injury to apple fruits, one by the adults and the other by the larvae. Damage by both adults and larvae allows infection by organisms causing rots, especially the bacterium *Pseudomonas melophthora* Allen & Riker. which is closely associated with all stages of *R. pomonella*. The oviposition punctures are small but, when numerous, they can result in distortion and down-grading of the fruit. Damage by larvae becomes visible as the fruit ripens and heavily infested fruit is unsaleable. Infestation of host fruits by the species feeding on cherry and *Ribes* causes down-grading. *Epoche ra canadensis* can severely limit the production of *Ribes* fruits unless controlled (16). Larval feeding by *R. completa* and *R. suavis* in developing walnuts results in stained and unmarketable nuts (29).

**Group 2 (3-9, 18)**

*Dacus tryoni* was reported as a serious pest in New South Wales as long ago as 1852 (27). It attacks a wide range of top and soft fruit as well as tomatoes. Larval damage renders the fruit unsaleable. In general the trypetid fruit flies are major pests of fruit and vegetables in the tropics and sub-tropics. Large sums of money have been spent to prevent their introduction into uninfested areas and on their control, particularly on produce for export.

Potential within EPPO Region

**Group 1**

There is insufficient information on the biology and ecology of any of the species for detailed assessment of potential. but. from a comparison of climates within their ranges in North America and Japan with those in the EPPO region. it seems that these pests could survive wherever their hosts are grown. Since its greatest importance as a pest is in the New England states of the USA and in the maritime provinces of Canada. *R. pomonella* is potentially a serious pest in north-west Europe and perhaps in mountain areas further south. Elsewhere. it might be a minor pest causing occasional severe damage as in the southern part of its North American range. How successfully the species attacking cherry would compete with the European cherry fruit fly. *Rhagolatis cerasi* (L.) cannot be predicted. but the other species would meet little or no competition from endemic species.
Adults of *Anastrepha ludens*.

Adult of *Dacus dorsalis*.
Dacus tryoni laying eggs in an apple
(Courtesy G.T. O'Loughlin, Dep. of Agriculture, Victoria, Australia).

Pear damaged by Dacus tryoni larvae
(Courtesy G.T. O'Loughlin, Dep. of Agriculture, Victoria, Australia).
*Decus* sp. larvae in young melon

(Courtesy Centre for Overseas Pest Research, London, GB.)
Diagnostic features of a Tryoetid larva: *Anastrepha ludens* (Courtesy G.H. Berg, San Antonio, USA).
Group 2
It is difficult to assess the potential of species in this group to become pests in the EPPO region. The greatest potential appears to be in those *Dacus* species that occur in northern India and in South Africa and in *D. tryoni*, although the latter is sensitive to low humidities which can cause severe mortality in both pupae and adults. Both *D. tryoni* and *Ceratitis rosa* have been recorded as displacing *C. capitata*, so they might also be able to do so in some parts of the latter's range in the EPPO region. The *Anastrepha* species are essentially tropical and sub-tropical; their potential is therefore likely to be more limited.

Means of Entry
All the trypetid fruit flies may be transported as larvae with fruit, or as puparia with packaging around fruit and in soil with host plants that are old enough to have fruited. For many species the risk of establishment is increased by the presence of several larvae in each fruit. There is also a small possibility of adults being transported in aircraft.

Identification

Damage
Similar damage is caused by most species. Oviposition punctures are difficult to detect when fresh but become more evident later, especially if the surrounding area discolours. Subsequent symptoms depend on the type of fruit and on the development of secondary infection but in immature fruit the only sign may be a slight flattening and softness in the skin as the underlying tissues begin to break down. Much damage may occur inside the fruit before external symptoms are seen, often as networks of tunnels accompanied by rotting. It is often difficult to detect infestation in its early stages, especially in thick-skinned fruits such as citrus. Heavily infested fruits often drop before harvest.

Adults
The Trypetidae is a large and easily recognisable family of acalypterate flies with characteristic patterned wings. A combination of characters distinguish the family: 1) on the wing - vein Sc with an abrupt nearly 90\(^\circ\) distal bend, weak beyond the bend and terminating, often as a fold, at a sub-costal break; 2) on the antenna - segment 2 with a longitudinal cleft; 3) vibrissae absent. In the female the ovipositor has a non-retractile oviscape (basal sheath). The wing span varies between 7 and 15 mm. The features of the economic species in the main genera are summarized below.

*Rhagoletis* (13, 20): the body is usually black or brown with an ivory or yellowish notopleural stripe from the humeral callus to the wing base, pale scutellum and sometimes pale transverse bands on the abdomen. The wings are patterned with 4 or 5 transverse dark bands with distally two joined at the costa to form an inverted V pattern sometimes bisected by a third band. The wing patterns are a useful guide to the economic species; wing length generally in the range 2.5-4 mm.

*Ceratitis* (9): *C. rosa* is similar to *C. capitata* in appearance with yellow-brown abdomen and lightly marked wings with a complex pattern proximal to the medial crossband, but the thorax is brown with a black scutellum marked with yellow. *C. rosa* may be distinguished from *C. capitata* in the male by its prominent tufts of hairs on the tibiae of the middle pair of legs and by the lack of the pair of spatulate-tipped hairs on the head. Wing length around 5 mm.

*Anastrepha* (34, 35): the listed species are yellow-brown flies with pale longitudinal stripes on the thorax. The wing patterning is orange-brown and includes a distinctive inverted V marking the apex of which usually lies in cell R5 though an extension may join the apex to the band along the costal margin. Wing length 6-8 mm. The ovipositor is as long as the rest of the body.
**Dacus** (18): body light brown to dark brown or blackish usually with pale markings on the thorax and a pale scutellum. Wings with a distinctive basic pattern of one dark band along the costal margin and another diagonally through the anal cell. Some species, e.g. *D. cucurbitae*, have additional transverse dark markings on the wings. Wing length 5-6 mm.

In some species the full colour pattern is not developed until 3-4 days after emergence. Adults bred for identification should therefore be fed and kept until the pattern is fully visible.

**Larvae** (12, 19, 22, 29, 33)

Elongate whitish dipterous larvae, up to 12 mm in length, usually feeding in the flesh of fruits. The two mouth hooks are strongly developed and equal in size. The body is tapered anteriorly and truncated at the posterior end. Each posterior spiracle has three openings or slits, arranged parallel or converging, on a sclerotised plate. For inspection purposes any dipterous larvae having these features and found in fruits should be regarded as probably trypetid. (Drosophilid larvae which are often found in decaying fruit are more tapered posteriorly with the posterior spiracles on a pair of terminal protuberances). Characters for separating the larvae of many of the species of Trypetidae are given in (12) and (29). Mature larvae of many species may jump when placed on a flat surface.

**Relevant Inspections**

Consignments of fruit and fruiting vegetables, such as cucurbits and tomatoes, from countries where the pests occur should be inspected for symptoms of infestation (punctures in or winding tunnels beneath the fruit skin, distortion of fruits, rotting fruits). Fruits with these symptoms should be cut open in order to look for larvae. Consignments of trees or shrubs, especially of *Malus*, *Pyrus*, *Cydonia*, *Prunus*, *Crataegus* and *Citrus* from countries where the pests occur, should be inspected for freedom from soil or soil samples should be taken and examined for pupae.

Adult flies can be trapped to detect incipient infestations or to monitor established colonies. Most Group 1 species can be trapped on yellow sticky traps. Sticky red spheres 7.5 cm in diameter have proved more selective than yellow cards as traps for *R. pomonella*. Group 2 species are better detected by bait traps (reviewed in 18).

**Treatments in Transit**

Trypetid larvae in fruit are usually killed by cold storage. Exposure times have been worked out for only a few species. For example, storage at about 0°C should eliminate larvae of *D. tryon* and *R. pomonella* in 14 or 40 days respectively (21, 27).

Fumigation can also be used where appropriate (24, 32).

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Wing markings on *Rhagoletis pomonella* and several other non-European Trypetidae. Wings of the European species *R. cerasi*, *R. alternata* and *Cerasitis capitata* are included for comparison. Not to scale. See text for typical wing lengths of the genera

(Composite plate: courtesy E.H. Glass, New York State Agricultural Experiment Station, USA, and Harpenden Laboratory, Harpenden, GB)
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