EPPO Datasheet: *Rhagoletis indifferens*

Last updated: 2021-10-21

IDENTITY

Preferred name: *Rhagoletis indifferens*
Authority: Curran
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Diptera: Tephritidae
Other scientific names: *Rhagoletis cingulata indifferens* Curran
Common names: western cherry fruit fly
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EPPO Categorization: A1 list
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EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: RHAGIN



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Notes on taxonomy and nomenclature

Rhagoletis indifferens and *R. cingulata* (Loew) are very closely related allopatric species, occurring respectively in the western and eastern parts of North America. Before 1966, only *R. cingulata* was generally recognized, and most pre-1966 literature did not make any distinction between the two species, even though distinct morphological differences between flies from the east and west were recognized in 1955 (Blanc & Kiefer, 1955). As a result, all records of *R. cingulata* in western North America refer to *R. indifferens*.

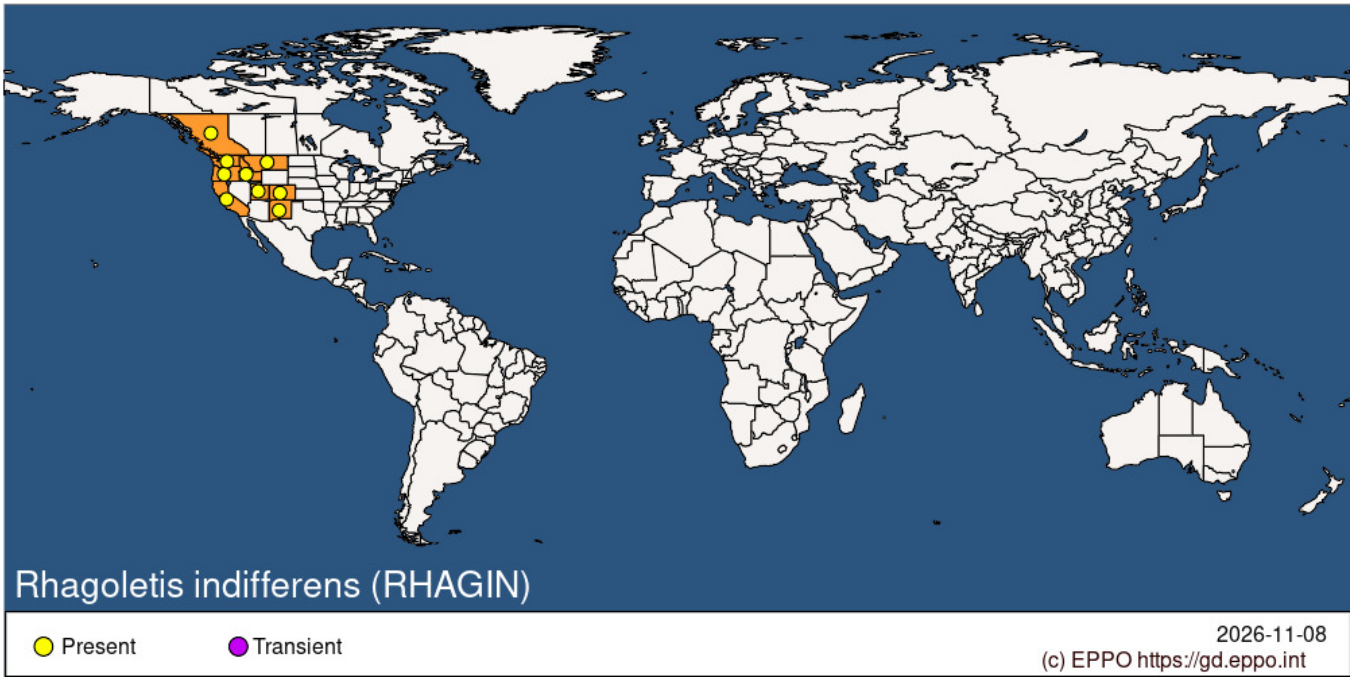
HOSTS

The principal cultivated hosts of *R. indifferens* are sweet cherry (*Prunus avium*) and tart cherry (*P. cerasus*). The native host of the fly is bitter cherry (*Prunus emarginata*) (Curran, 1932; Foote & Blanc, 1963; Bush 1966; Yee *et al.*, 2011, 2015a). Cherry plum (*Prunus cerasifera*), cherry laurel (*Prunus laurocerasus*), mahaleb cherry (*Prunus mahaleb*), and bird cherry (*Prunus padus*) are also host plants that appear commonly attacked. Rare hosts are black hawthorn (*Crataegus douglasii*), cascara buckthorn (*Frangula purshiana*), Chinese crab apple (*Malus spectabilis*), apricot (*Prunus armeniaca*), and chokecherry (*Prunus virginiana*). Pin cherry (*Prunus pensylvanica*), Japanese plum (*Prunus salicina*), and Klamath plum (*Prunus subcordata*) are also host plants, but how commonly they are attacked is unclear (Frick *et al.*, 1954; Ellertson, 1961; Yee, 2008; Yee & Goughnour, 2005a; 2008; Yee & Klaus, 2013; Yee *et al.*, 2010; 2018a). In the EPPO region, *P. avium* and *P. salicina* would be the main potential hosts. Under laboratory conditions, *R. indifferens* oviposits in and larvae can develop in mango (*Mangifera indica*), common plum (*Prunus domestica*), and nectarine (*Prunus persica*) (Yee & Goughnour, 2017a).

Host list: *Crataegus douglasii*, *Frangula purshiana*, *Malus spectabilis*, *Prunus armeniaca*, *Prunus avium*, *Prunus cerasifera*, *Prunus cerasus*, *Prunus emarginata*, *Prunus laurocerasus*, *Prunus mahaleb*, *Prunus padus*, *Prunus salicina*, *Prunus subcordata*, *Prunus virginiana*

GEOGRAPHICAL DISTRIBUTION

Rhagoletis indifferens is found in western North America, from California in the United States north to British Columbia, Canada (Bush, 1966; Yee *et al.*, 2014a). According to Foote *et al.* (1993), *R. indifferens* is found in nine states in the United States: California, Colorado, Idaho, Montana, New Mexico, Oregon, Utah, Washington, and Wyoming. In the Pacific Northwest states of Washington and Oregon where the sweet cherry industry in the United States is concentrated, the fly is found almost exclusively in bitter cherry or in unmanaged sweet and tart cherry trees in yards and roadsides, and not in commercial orchards, which if properly managed are usually free of the fly (Smith 2005). Previous records of *R. indifferens* in the EPPO region were based on misidentifications of *R. cingulata* (Augustinos *et al.*, 2019).



North America: Canada (British Columbia), United States of America (California, Colorado, Idaho, Montana, New Mexico, Oregon, Utah, Washington)

BIOLOGY

Eggs are laid below the skin of the host fruit and, in cherries, hatch after 5-8 days (Frick *et al.*, 1954). Larvae feed exclusively inside fruit. The first instar stage lasts 2-5 days; the second instar averages 4 days; the third instar averages 8 days. Pupariation is in the soil under the host plant, where puparia overwinter. A prolonged chilling period is required to terminate diapause and for pupae to develop into adults. Adults eclose from puparia in soil in late spring or summer. Flies feed indiscriminately on leaf and fruit surfaces, ingesting leachates that may contain sugars, bacteria, yeasts, amino acids, and minerals. Males use fruit as territories for mating (there is no true courtship) and defend them against other males. Females reach reproductive maturity and begin ovipositing about 1 week post-eclosion. Adult *R. indifferens* may live 15-30 days under field conditions in central Washington (Frick *et al.*, 1954).

DETECTION AND IDENTIFICATION

Symptoms

Attacked cherries have punctures caused by stinging by the females' ovipositor. In advanced stages of larval infestation, cherries become discolored and soft. Larval respiration holes and exit holes are commonly seen when larvae are at the third instar stage or have left fruit, respectively.

Morphology

Separation of *R. indifferens* and *R. cingulata* larvae and adults (Blanc and Kiefer 1955, Bush, 1966) is difficult morphologically and should be referred to a specialist.

Egg

The egg is white and elongated.

Larva

Larvae are whitish or creamy, legless, maggot-like and the last instar is about 8 mm long, see Phillips (1946) and Frick *et al.* (1954). *Rhagoletis indifferens* larvae can be separated from *R. cingulata* larvae by the numbers of papillae on the thoracic spiracles, with *R. indifferens* having 10-18 while *R. cingulata* has 21-31; in addition, *R. indifferens* larvae have a single row of papillae while *R. cingulata* larvae have at least two rows (Blanc and Kiefer 1955).

Adult

Adult females average about 5.2 mm in length with a wingspan of 3.7 mm while males average 4.4 mm in length with a wingspan of 3.3 mm (Yee *et al*., 2011).

Head: Three pairs of frontal setae; genae usually less than one-quarter eye height; ocellar setae long, usually similar in length and strength to orbital setae; two pairs of orbital setae; 1st flagellomere usually with a small antero-apical point.

Thorax: Scutum predominantly black, with four longitudinal bars of tomentum that form grey stripes; scutum with dorsocentral setae based close to a line between the anterior supra-alar setae; scutum with dorsocentral setae and presutural supra-alar setae; anatergite without long pale hairs, at most with a fine pubescence; scutellum flat and with four marginal setae (one basal and an apical pair), black at base and sides, with basal and lateral black areas broadly joined; basal scutellar setae based well within black area.

Black shading on the posterior surface of coxa I separates *R. indifferens* from *R. cingulata* adults and all other members of the *cingulata* species group (Bush, 1966).

Wing: Vein Sc abruptly bent forward at nearly 90°, weakened beyond this bend and ending at subcostal break; vein R1 with dorsal setulae; vein R4+5 usually without dorsal setulae, except sometimes at the base of the vein (except in some aberrant individuals); apex of vein M meeting C with a distinct angle; cup extension short, never more than one-fifth as long as vein A1+Cu2, and vein CuA2 straight along anterior edge of cup extension; cell cup always considerably broader than half depth of cell bm, and usually about as deep as cell bm; cells r1 and r2+3 without any markings between the discal and preapical crossbands; apical crossband usually only divided at apex, leaving an oblique hyaline stripe across the apex of cell r4+5; apical cross band adjoining vein C. Length 3-4 mm.

Rhagoletis indifferens usually has no apical wing spot (found in only 1.4% of individuals) while *R. cingulata* usually has an apical wing spot (present in 65.8% to 75.8% of individuals) (Bush, 1966).

Abdomen: Predominantly black; female with an ovipositor (aculeus) about 0.83 mm long (Bush, 1966) that is shorter than the wing length, and straight.

Detection and inspection methods

Traps already in use within the EPPO region for the European cherry fruit fly *R. cerasi* should be suitable for monitoring any invasion of *R. indifferens*. These traps capture both sexes and are based on visual, or visual plus odour, attraction. They are coated with sticky material. Traps are usually either flat-surfaced and coloured various shades of yellow (panels) to elicit a supernormal foliage response, or spherical and dark-coloured to represent a fruit. The odour comes from protein hydrolysate or other substances emitting ammonia, such as ammonium acetate or carbonate. Burditt (1988) evaluated different traps for *R. indifferens* in British Columbia, Canada, and Yee (2013, 2014b, 2016, 2017b, 2018b, 2019) has evaluated traps against *R. indifferens* in Washington State in the USA.

PATHWAYS FOR MOVEMENT

Adult flight and the transport of infested fruits are probably the major means of movement and dispersal of *R. indifferens* to previously non-infested areas. However, in general, *R. indifferens* is not known to fly long distances. In mark-release-recapture studies in Washington State, *R. indifferens* dispersed 67 m to 171 m (Frick *et al.*, 1954; Jones & Wallace, 1955). In British Columbia, 96% of released *R. indifferens* were captured within 100 m of their release point (Senger, 2007). In international trade, the major means of dispersal to previously non-infested areas is presumably the transport of fruits containing live larvae. There may also be a risk from the transport of puparia in

soil or packaging with plants that have borne fruit. *R. cingulata*, another cherry fruit fly originating in the Eastern USA, has been introduced and spread into Europe in the 2000s (EFSA PLH Panel, 2014).

PEST SIGNIFICANCE

Economic impact

Rhagoletis indifferens is an important quarantine pest of cherries in western North America. Quarantine agreements between the Pacific Northwest states and other US states or countries result in a zero tolerance for cherry fruit fly larvae in packed fruit, leading to rejection of an entire load when a larva is found. The fly is mostly found in unmanaged sweet and sour cherry trees and not in commercial orchards where pest management is applied (Smith, 2005; Yee *et al.*, 2014a).

Control

Control procedures already established in the EPPO region for *R. cerasi* and *R. cingulata* are similar to those used against *R. indifferens* and could therefore be implemented against any introduction of this species within the EPPO region. If possible, wild and abandoned host plants near commercial cherry orchards should also be removed. Organophosphates, such as malathion and dimethoate, have long been known to be highly effective, killing eggs, larvae and/or adults of *R. indifferens* (Zwick *et al.*, 1970; 1975). Spinosad in baits and other insecticides have been identified that are highly toxic to *R. indifferens* (e.g., Yee, 2009; 2010; 2015b; 2020a; Yee & Alston, 2006; 2012) and have been successful in managing the fly (Yee & Alston, 2006). Biological control agents against *R. indifferens* have also been studied in the laboratory, focusing on nematodes and fungi (Yee, 2003; 2005b; 2020b; Cossentine *et al.*, 2011). These agents have shown promise although their efficacies have yet to be demonstrated in the field.

To reduce the probability of pest presence in traded fruits, in the Pacific Northwest of the USA, cherries are checked for larvae at the packinghouses before fruit are shipped using the brown sugar flotation method, which has been shown to be highly efficacious in detecting larvae (Yee, 2012; 2014c).

Phytosanitary risk

R. indifferens is a damaging fruit fly in North America and *Prunus* species are important crops in the EPPO region. Considering the pest current range in North America, it is likely that this species could establish in part of the EPPO region. Although control measures already applied against other fruit flies in cherry production may limit its impact, it may be needed to adapt IPM procedures to cover a longer period of infestation.

PHYTOSANITARY MEASURES

Consignments of cherries (*Prunus avium*, *P. cerasus*) from regions where *R. indifferens* occurs should be inspected for symptoms of infestation and those suspected should be cut open in order to look for larvae. Fruits should come from areas where *R. indifferens* does not occur, or from a place of production found free from the pest by regular trapping before harvest in addition to use of the brown sugar flotation method post-harvest at the packinghouse. Cherries may also be treated effectively using methyl bromide to kill eggs and larvae (Jones & Schuh, 1953; USDA, 2021), but this may reduce cherry shelf life. Irradiation (Burditt & Hungate, 1988) and combined heat and controlled atmosphere treatments (Neven & Rehfield-Ray, 2006) are also effective at controlling *R. indifferens* in cherries. Similar measures may be considered for fruit of other host plants, but those species either produce fruits that are not widely traded (e.g. *P. cerasifera*, *P. salicina*) or are rarely attacked.

Plants of host plant species transported with roots from regions where *R. indifferens* occurs should be free from soil. Such plants (see host list) may be prohibited from importation.

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Datasheet history

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