

UDC 595.773.4

## A REVIEW OF FRUIT FLIES OF THE GENUS *RHAGOLETIS* (DIPTERA, TEPHRITIDAE) OF IRAN AND BORDERING COUNTRIES, WITH THE KEY TO SPECIES

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Accepted 29 December 2008

**A Review Of Fruit flies of the Genus *Rhagoletis* (Diptera, Tephritidae) of Iran and bordering countries, with the key to species. Mohamadzade Namin S., Rasouljan G. R.** — The genus *Rhagoletis* Loew includes many economically important pests of fleshy fruits. Six species of this genus occurring in Iran and bordering countries are briefly reviewed, and a key to species is provided. *Rhagoletis flavicincta* Enderlein is recorded for the first time from Iran.

**Key words:** Diptera, Cyclorrhapha, Tephritidae, *Rhagoletis*, Iran, fauna, key to species.

**Обзор плодовых мух рода *Rhagoletis* (Diptera, Tephritidae) из Ирана и сопредельных стран, с таблицей для определения видов. Мохамадзаде-Намин С., Расулиан Г. Р.** — Род *Rhagoletis* Loew включает в себя многочисленных экономически важных вредителей плодовых культур. Дан краткий обзор 6 видов рода, встречающихся в Иране и соседних странах. Составлена таблица для определения этих видов. *Rhagoletis flavicincta* Enderlein впервые отмечен из Ирана.

**Ключевые слова:** Diptera, Cyclorrhapha, Tephritidae, *Rhagoletis*, Иран, фауна, таблица для определения видов.

The genus *Rhagoletis* Loew includes 64 described species in the Holarctic, Oriental, and Neotropical Regions (Korneyev, Merz, 1997; Richter, Kandybina, 1997; Norrbom et al., 1999). It belongs to the tribe Carpomyini (subfamily Trypetinae) (Norrbom, 1989; Korneyev, 1995; Norrbom et al., 1999).

Several species of *Rhagoletis* infest cherries, apples, tomatoes, and some other commercially grown fleshy fruits, being sometimes pests of economic importance. Most species of known biology are stenophagous attacking the fruits of a few closely related plant species. The larvae of *Rhagoletis* spp. develop in the flesh of their host fruit and usually are univoltine (White, Elson-Harris, 1992); the latter book also contains the most important references on the biology and control of the pest species.

The only taxonomic revisions of the genus were those by Rohdendorf (1961) for the territory of the former Soviet Union, Bush (1966) for the Nearctic Region and Foote (1981) for the Neotropical Region. In the Palaearctic Region, keys to species were provided by Merz (1994) for Central and West Europe, Korneyev, Merz (1997) for the Middle Asian countries of the former Soviet Union, and by Korneyev, Ovchinnikova (2004) for Far East Russia. Keys and descriptions of larvae were given by Kandybina (1977). Phylogenetic relationships were recently analyzed by Smith et al. (2006); that work contains also a discussion of previous analyses of relationships among species of the genus. However, the genus is very poorly examined in the Near East, and there is no comprehensive taxonomic treatment or key to species of this region is available.

Fruit flies of the genus *Rhagoletis* can be recognized by the combination of the wing pattern consisting of 4 or 5 crossbands, acuminate black or yellow postocular setae, cell *bcu* with the posteroapical lobe along the anal vein, male genitalia with long saber-like surstyli and female terminalia with short oviscapes forming soft, desclerotized T-shaped areas at the apex. Postpedicel with a dorso-apical point; hindfemur at tip anteroventrally with some longer setulae; aculeus pointed, straight, not serrate. Closely related species of the genus *Carpomya* Costa (s. l., including *Myiopardalis* Bezzi and *Goniglossum* Rondani) differ mainly by having a black spotted pattern of the mesonotum and/or short ocellar seta. Some authors (e. g., Smith et al., 2006) give evidence that they belong to the same monophyletic lineage and might be classified in one large genus.

In spite of their economic importance the species of *Rhagoletis* species occurring in Iran, have received little study. Six species are recorded from Turkey, Turkmenistan, Azerbaijan, Armenia, Georgia and North Caucasus of Russia: *R. bagheera* Richter and Kandybina, *R. berberidis* Jermy, *R. caucasica* Kandybina and Richter, *R. cerasi* (Linnaeus), *R. flavicincta* Enderlein, *R. flavigenualis* Hering. Two of them *R. cerasi* and *R. flavigenualis* have been recorded from Iran. In the Palaearctic Region, the center of *Rhagoletis* diversity (15 species) lies in the mid-altitudes (1000–2500 m a. s. l.) of Tien Shan and Pamir Mountains of the Central Asia (Korneyev, Merz, 1997). This region is connected by mountain chains from Iran and some of the species recorded from this region may also occur in Northern Iran.

As our knowledge of the Iranian fauna is incomplete, the following key is compiled to facilitate determination of *Rhagoletis* species occurring in Iran and bordering countries.

#### Material and methods

The specimens examined in this study were collected by sweeping and deposited in Zoological Museum in University of Tehran, Karaj. Figures of the wings are based on the photographs taken with a digital camera through the microscope eyepiece.

Morphological terminology follows White et al. (1999).

#### Key to Species of *Rhagoletis* occurring in Iran and bordering countries\*

##### Таблица для определения видов рода *Rhagoletis* из Ирана и сопредельных стран

Species not yet recorded from Iran were not available for study and are included into the key based on their original descriptions only.

- 1(2). Mesonotum reddish-yellow, without dark pattern, microtrichose. Intercalary wing crossband apical between discal and subapical crossbands present (fig. 1, 3). Posterior orbital setae reclinate. Abdominal terga with largely confluent black spots. Aculeus 2.5 times longer than subcostal cell. 3.7–4. .... *R. caucasica* Kandybina and Richter
- 2(1). Mesonotum black, other characters variable. .... 3
- 3(6). Wing pattern with a small intercalary band crossing cells  $r_1$  and  $r_{2+3}$  between discal and subapical crossbands. .... 4
- 4(5). Apical band clearly reaching into the cell  $m_{1+2}$  (fig. 1, 4). Scutellum yellow with narrowly blackened basally (fig. 2, 2); Scutum gray microtrichose, (in Central Asian specimens femora black). 2.5–3.7. Larvae in *Prunus*, *Lonicera*. .... *R. cerasi* Linnaeus
- 5(4). Apical band usually not reaching to cell  $m_{1+2}$  (fig. 1, 2). Scutellum at base broadly blackened (fig. 2, 1). Scutum shining. Associated with *Berberis* spp. .... *R. berberidis* Jermy
- 6(3). Wing pattern without such band. .... 7
- 7(8). Apical band of wing touching costa along its entire length, or at most slightly separated from costa at point of confluence with veins  $R_{2+3}$  and  $R_{4+5}$  (fig. 1, 5) Coloration of femora and abdomen various. Larvae in *Lonicera* spp. .... *R. flavicincta* Enderlein
- 8(7). Apical band of wing separated from costa by a hyaline area in at least cells  $R_{2+3}$  and  $R_{4+5}$  (fig. 1, 5). .... 9
- 9(10). Mid- and hindfemora black. 3.5–4.5. Wing length 2.0–2.7 in male and 2.2–2.5 in female. Larvae in *Rhamnus pallasii*. .... *R. bagheera* Richter and Kandybina
- 10(9). Midfemur entirely yellow, hindfemur mostly yellow. Posterior surface of head completely yellow, at most with narrow streaks. Wing pattern brownish-yellow (fig. 1, 6). Larvae in *Juniperus* spp. .... *R. flavigenualis* Hering

#### *Rhagoletis bagheera* Richter & Kandybina, 1997 (fig. 1, 1)

Richter, Kandybina, 1997.

Material not examined.

**Diagnosis** (compiled after Richter, Kandybina, 1997). Head yellow, antenna and frontal strip dark yellow. Flagellomere 1 pointed apically. Scutum black, with 4 gray microtrichose vittae. Wing pattern as in *R. flavigenualis*, without intercalary crossband; apical band separated from costa by hyaline area in cells  $r_{2+3}$  and  $r_{4+5}$  (fig. 1, 1). Mid and hind femora black. Abdomen entirely black. This species is similar to *R. batava* Hering and according to the description the only difference is the size of body and wings (wing length in *R. bagheera* is 2.0–2.7 mm in male and 2.2–2.5 mm in

\* More species occurring in Tadjikistan, Uzbekistan and Kyrgyzstan can be identified with the key by Korneyev, Merz (1997); most species from the Central Palaearctics can be determined with that and the present keys.

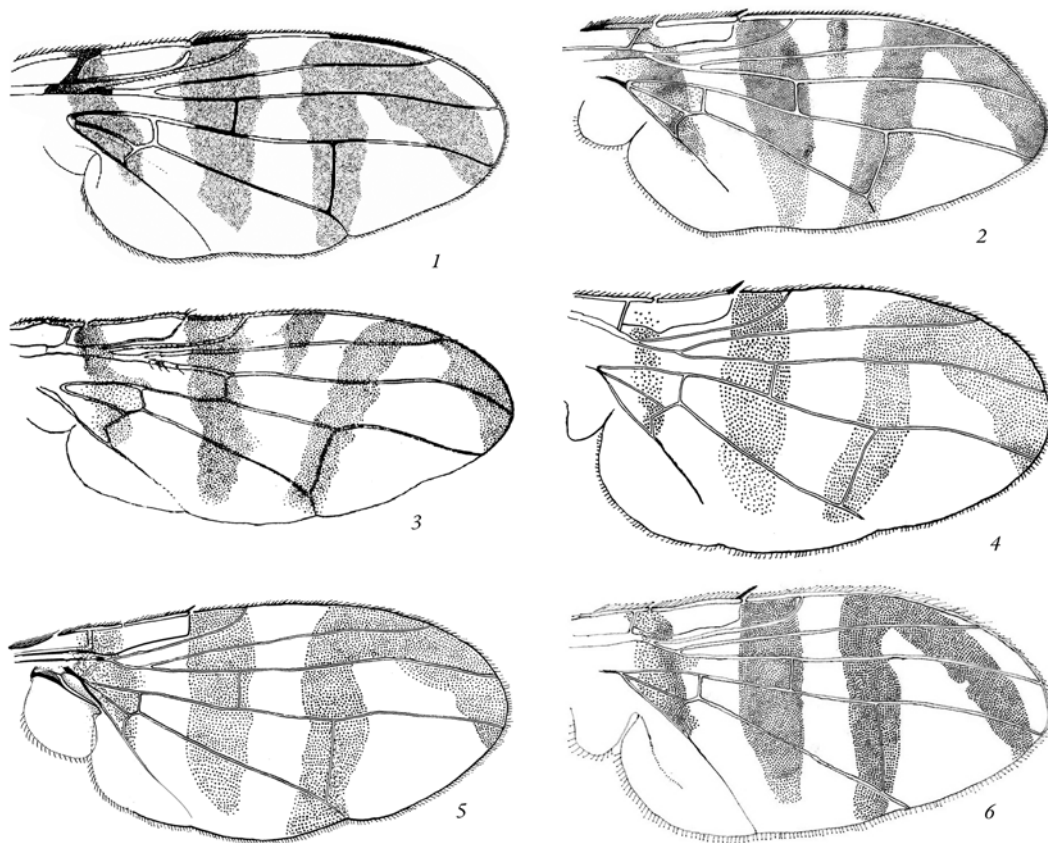


Fig. 1. *Rhagoletis* spp., wings: 1 — *R. bagheera* (from Richter, Kandybina, 1997) (in *R. batava* wing pattern similar); 2 — *R. berberidis* (redrawn from Merz, 1994); 3 — *R. caucasica* (from Kandybina, Richter 1976); 4 — *R. cerasi*; 5 — *R. flavicincta*; 6 — *R. flavigenualis*.

Рис. 1. *Rhagoletis* spp., крылья: 1 — *R. bagheera* (по: Рихтер, Кандыбина, 1997) (у *R. batava* рисунок крыла сходен); 2 — *R. berberidis* (redrawn from Merz, 1994); 3 — *R. caucasica* (по: Кандыбина, Рихтер, 1976); 4 — *R. cerasi*; 5 — *R. flavicincta*; 6 — *R. flavigenualis*.

female, whereas in *R. batava* 2.5–3.2 mm in male and 2.6–3.2 in female) and also by different host plants (*Hippophae rhamnoides* (Elaeagnaceae) in *R. batava*).

Host plant. *Rhamnus pallasii* (Rhamnaceae).

Distribution. Armenia (type locality: Erevan), E Georgia.

***Rhagoletis berberidis* Jermy, 1961 (fig. 1, 2; 2, 1)**

Merz, 1994; Norrbom et al., 1999; Kütük Özasan, 2006.

Material not examined.

Diagnosis (compiled after Merz, 1994). Occiput, most of thorax and abdomen shining black. Wing length: 3.2–4.0 (male), 3.5–4.5 (female); pattern black, with small

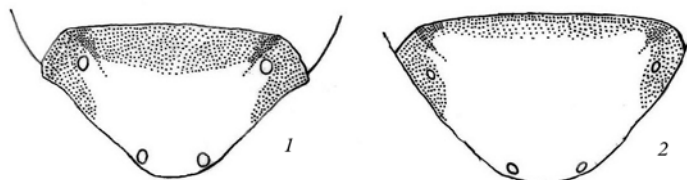


Fig. 2. *Rhagoletis* spp., scutellum: 1 — *R. berberidis*; 2 — *R. cerasi* (redrawn from Merz, 1994).

Рис. 2. *Rhagoletis* spp., щиток: 1 — *R. berberidis*; 2 — *R. cerasi* (перерисовано из: Merz, 1994).

intercalary band crossing cells  $r_1$  and  $r_{2+3}$  between discal and subapical crossbands, apical crossband usually not extending into cell  $m_{1+2}$  (fig. 1, 2); Scutellum yellow, at the base broadly blackened (fig. 2, 1). Body length: 4.0–5.1 (male); 4.5–6.2 (female).

Host plants. *Berberis vulgaris* (Berberidaceae) (Merz, 1994).

Distribution. Austria, Hungary (type locality), Russia (North Caucasus), Switzerland, Turkey and Ukraine (Foote, 1984; Merz, 1994; Korneyev, Merz, 1997; Norrbom et al. 1999).

***Rhagoletis caucasica*** Kandybina & Richter 1976 (fig. 1, 3)

Kandybina, Richter 1976.

Material not examined.

Diagnosis (compiled after Kandybina, Richter, 1976). Posterior orbital setae reclinate. Mesonotum microtrichose, reddish-yellow, without dark pattern. Wing length 4.15 mm, with brown pattern: anterior apical wing band narrowly fused to subapical, posterior apical crossband absent; small intercalary band crossing cells  $r_1$  and  $r_{2+3}$  between discal and subapical crossbands present (fig. 1, 3). Abdominal tergites 2, and 4–6 with brown lateral spots in female or tergites 2–5 with brown anterior half in male. Oviscape 1.3–1.4 times as long as tergite 6. Body length 3–3.5 mm.

Host plants. *Berberis* sp. (Berberidaceae) (Kandybina, Richter, 1976)

Distribution. Russian Federation (North Caucasus: Kabardino-Balkaria. Type locality: “Caucasus, Tyrny-Auz”).

***Rhagoletis cerasi*** (Linnaeus, 1758) (fig. 1, 4; 2, 2) — European Cherry Fly

Hendel, 1927; Korneyev, Merz, 1997; Richter, 1988; Norrbom et al., 1999; К?т?к, Цзаслан, 2006.

Material examined: 1 ♂, 1 ♀, 7 km east Pelour, Haraz road, Tehran province, 30.05.2008 (Mohamadzade leg.).

Diagnosis. Mesonotal scutum with four vittae of grey microtrichia. Wing pattern with a small intercalary band crossing cells  $r_1$  and  $r_{2+3}$  between discal and subapical crossbands and apical band clearly reaches into the cell  $m_{1+2}$  (fig. 1, 4). Femora black. Scutellum yellow, at most narrowly blackened basally (fig. 2, 2). Body length 2.5–3.7 mm.

Host plants. Cherries (*Prunus cerasus*, *P. avium*, *P. serotina* and *P. mahaleb* (Rosaceae)) and honeysuckles: *Lonicera tatarica*, *L. xylosteum* (Caprifoliaceae) (Afshar, 1937; Hendel, 1927; Kandybina, 1977; White, Elson-Harris, 1992; Merz, 1994).

Distribution. Most of Europe (type locality: “Europe”), Russia (European Territory and Western Siberia), NW Kazakhstan, Georgia, Turkey and Iran (N, NW, NE, E, Cent. and S) (Afshar, 1937; Giray, 1979; Kandybina, 1977; Norrbom et al. 1999).

***Rhagoletis flavicincta*** Enderlein 1934 (fig. 1, 5)

Rohdendorf, 1961; Richter, 1988; Kandybina, 1977; Korneyev, Merz, 1997.

Material examined. Iran: Tehran Province, Mahan village, Chaloos road, 10.09.2008, 1 ♂ (Mohamadzade leg.).

Diagnosis. Head light yellow; frontal strip reddish. Flagellomere 1 of antenna is twice as long as scape, pointed apically; arista very short pubescent. Frons in male wider than eye, in female as wide as eye. Frontal strip with few, short black setulae. Thorax black; scutellum yellow. Legs yellow, coloration of femora various. Mesonotum with 4 grey microtrichose vittae. Wing pattern consisting of 4 dark brown crossbands, without small intercalary band (fig. 1, 5); apical band touching costa, not separated by hyaline area. Abdominal tergites partly yellow, with black spots in males and black transverse crossbands at base of tergites in female. Body length 2.7–4.0 mm.

Host plants. *Lonicera tatarica*, *Lonicera stanantha* (Rohdendorf, 1961), *Lonicera nummularifolia* (Korneyev, Merz, 1997), and probably some other *Lonicera* spp.

**Distribution.** European Russia (Volgograd (“Sarepta” — type locality) and Voronezh Regions), Ukraine (Lugansk Region); Kazakhstan, Kyrgyzstan, Tadjikistan (Rohdendorf 1961), Uzbekistan (Kandybina, 1977), Iran (new record). Records from Germany (Rohdendorf, 1961; Kandybina, 1977) are based on a mistake (V. A. Korneyev, pers. comm.).

***Rhagoletis flavigenualis* Hering, 1958 (fig. 1, 6)**

Hering, 1958; Rohdendorf, 1961; Kandybina, 1977; Korneyev, Merz, 1997; Merz, 2006; Gilasian, Merz, 2008.

**Material examined.** Iran: Tehran Province, Mahan village, Chaloos road, 10.09.2008, 1 ♂, 2 ♀ (Mohamadzade leg.).

**Diagnosis.** Head reddish-yellow; occiput yellow with narrow black strikes. Flagellomere 1 pointed apically. Thorax black, mesonotal scutum with 4 densely grey microtrichose vittae. Wing with 4 brownish yellow crossbands, small intercalary band absent, apical band separated from costa by a hyaline area at least in cells  $r_{2+3}$  and  $r_{4+5}$  (fig. 1, 6). Midfemur yellow and hindfemur mostly yellow. Abdomen black with yellow posterior margins of tergites. Body length 4.0–4.8 mm.

**Host plants.** *Juniperus excelsa*, *J. seravschanica* and *Juniperus* spp.

**Distribution.** S Kazakhstan, S Kyrgyzzia, Switzerland, Tadjikistan, S Turkmenistan, Turkey (type locality: S. Anatolia, Antalya-Kas, Katrandag), N and NW Iran (Gilasian, Merz, 2008).

We wish to express my sincere thanks to Dr. Valery A. Korneyev for providing us with necessary literature and translation of diagnoses from Russian, confirmation of identification of some specimens, reading early versions of this manuscript and useful critical comments. We grateful to Dr. Bernhard Merz for sending reprints and kind assistance during our studies of Tephritidae. We also thank Masoud Hakimitabar (Ph. D. student of Acarology at the University of Tehran) for his help to the first author during fieldwork and two anonymous reviewers for their critical comments and corrections.

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